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AN ECONOMIC INVESTIGATION OF THE MONTANE TUSSOCK-GRASSLAND OF NEW ZEALAND.

XII. THE REGRASSING EXPERIMENTS IN CENTRAL OTAGO.

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PART III.—RESULTS UP TO MAY, 1922.

IN Parts I and II of this article a fairly detailed account of the regrassing problem has been presented, together with the methods so far adopted for its solution. It has been seen that any regrassing operations in Central Otago, where depletion is at its maximum, must perforce be carried out under extremely adverse climatic conditions. But worse even than the hostile climate is the presence of rabbits in vast numbers, which, unless they can be reduced to a negligible minimum, must forbid the establishment of most pasture-plants. However, the rabbit factor does not at present concern these experiments, since they are designed to ascertain if, at a reasonable price, it is possible to establish plants of pasture-value upon the wind-swept, sun-scorched, bare, arid hillsides where irrigation is impossible.

In regard to what follows, it must once more be emphasized that these experiments are not demonstrations to teach how regrassing may be carried out. Even where, under the methods adopted, certain pasture-plants are now well established in fair abundance (see the various figures) this by no means proves that they are the most

suitable, or that they would remain established under grazing-conditions, or that a cheaper method for their establishment is not possible. The seed-mixtures used were not such in the ordinary acceptation of the term, but were designed as a rapid method of placing various species simultaneously on the plots, in order to study their individual behaviour and to learn something about the germinating-capacity of the seeds under many conditions.

Although sunny and dark faces must require different treatment the same seed-mixture was used for both, as a preliminary to gauge the value of each species under the quite contrary conditions; consequently failure in germination must be in most cases attributed to this procedure, and not to the supposition that the particular class of country is incapable of being regrassed. Then each plot was similarly subdivided for the sowings, with the consequence that, owing to dissimilar conditions, the raked and broadcast results cannot in certain instances be compared with one another.

The experiments were so designed as to investigate, side by side, the effects of (1) spelling, and (2) regrassing by means of sowing. As spelling consists merely in keeping the ground free from stock and rabbits, it is capable of rapid and accurate investigation, for the time allowed must not occupy longer than could pay in practice. To gain information of practical value from the results of sowing is a far slower and more complicated matter. It is most unlikely that any plan can be devised which would bring about a sufficiently close pasture all at once. The first object, then, is to learn what species can be established at a reasonable distance from one another, and the next, to what extent, and in what time, these will extend their area of occupation by seeding or other means. With such information available concerning a sufficient number of suitable plants, seed-mixtures designed for sunny or dark faces and for good or bad soils could be tested, and the regrassing problem would be well on the way towards solution. With this ideal in mind, the practical man conversant with arid Central Otago, reading this article and seeing the illustrations, can judge for himself the degree of progress which has been reached.

CLIMATE IN RELATION TO GROWTH ON THE PLOTS.

The relation between the establishment of the experimental plants and the climatic conditions to which they were exposed is a matter of fundamental importance. Unfortunately, no meteorological statistics are available concerning the actual scene of the operations. But the climate of Clyde is not very different from that of the plots situated at an altitude of about 1,000 ft., though possibly slightly wetter. The statistics which follow, then, are those of Clyde, and they are available thanks to Mr. H. E. Stevens. These statistics, since the rainfall gradually increases with increase in altitude, do not truly indicate the somewhat higher degree of moisture of the upper plots. Nevertheless the Clyde figures serve quite well as a basis on which to judge how the climate of the period of the experiments compared with the average—be this wetter or drier than that of Clyde.

Here a detailed account of the climate is not presented in the usual form, but rather is stress laid on what specially concerns the plant-life of the plots, and particularly that which would hasten or delay germination or the growth of young plants. Thus an especially critical

time is January, February, and March, at which period more or less constant and excessive heat, combined with insufficient moisture in the soil, greatly hinders growth, and the leaves of the introduced pasture-plants are dried up. At this period a monthly rainfall of 1 in. or even 2 in., spread over several non-consecutive days, is of little value for plants, while on the steep, hard, bare slopes where regrassing is to be attempted even 1 in. of rain runs off so rapidly that very little can reach the roots of the plants.

It is during September, October, and November that rapid, vigorous growth takes place; at that period such rain as falls has its maximum effect, and any amount above the average should cause more than average growth. The latter, too, is stimulated by the warm weather even of this period of the year. It is spring rain in greater abundance than usual which would give a false idea of growth, rather than a similar excess of moisture from December to March, inclusive. In April and May more or less growth takes place; but in the latter month there are usually a good many frosts, which will have a restraining effect. As for frost in general, it is not so much the degree of intensity which counts, for that never reaches anywhere near the killing-point for pasture-plants, but its continuance day by day. The amount of late autumn and winter rain or snow is of prime importance, since if above the average there will be an extra amount of water in the soil available for spring growth. Snow, especially a late fall, is markedly beneficial in this respect, for, on melting, its water will gradually moisten the ground. But only plots 11 and 12 receive appreciable benefit from this source.

Coming next to some essential details regarding the climate for the period of the experiments—that is, the years 1920, 1921, and the first four months of 1922—the rainfall was: 1920, 13·20 in.; 1921, 16·34 in.; 1922 (4 months), 7·35 in. Going deeper into the question of rainfall, that for the first five months of 1920, from which would come a large percentage of the moisture in the soil available for the germination of the May sowing, was only 4·17 in. Further, this amount would be greatly reduced not only by run-off but by the hot summer sun, as evidenced by the maximum shade-temperatures for the five months, as follows: January, 93° F.; February, 101°; March, 90°; April, 90°; and May, 69°. Moreover, during the first four of those months, out of the 120 days the number with a maximum shade-temperature over 80° and from 70° to 79° respectively was fifty-four and forty-two, which means that during about 80 per cent. of the days the bare ground would be exposed to the fierce rays of the sun.

For the successful germination of the September sowing the soil conditions were more favourable, as an additional 3·19 in. of rain had fallen during June, July, and August, when evaporation would be at its minimum. This amount of rain, though small enough, was sufficient, as will be seen, to ensure good germination.

Now come the all-important details regarding the climate of September, October, and November, when the seedlings of both sowings would have to become firmly fixed in the ground and sufficiently developed to withstand the hot and probably dry weather of the next four months. For this primary establishing the total rainfall and the number of rainy days were only 2·98 in. and twenty-four

days. The following details of this small rainfall, month by month, are specially instructive: September, 0·95 in., on eleven days, with maximum day's fall of 0·54 in.; October, 0·20 in., on five days, with maximum of 0·05 in.; November, 1·83 in., on eight days, with maximum of 0·72 in. Thus, during these most critical three months the young plants experienced only two fair showers (0·54 in. and 0·72 in. respectively), while in October there was virtually a drought, and the remaining rain for these three months fell in quite trivial amounts. But to grasp the severity of the climate for germination and subsequent growth this same amount of rain available for growth must be considered in relation to the temperature, which was as follows: September, maximum (shade) 75°, minimum 22°; the shade maxima on nine days were from 70° to 79°, on fourteen days 60° to 69°, and on the remaining days 50° to 59°; there were ten frosts, four of which were continuous. October, maximum (shade) 86°, minimum 29°; the shade maxima on twelve days were 80° and upwards, on fourteen days from 70° to 79°, and the remaining days 60° to 69°; there was frost on seven days. November, maximum 82°, minimum 34°; the shade maxima on three days were 80° and upwards, on nineteen days 70° to 79°, and the remaining days 60° to 69°. Then there would certainly be high desiccating winds at times, but of these I have no record.

The foregoing account of perhaps the most critical period for the young plants shows that the conditions to which they were exposed were extremely severe, and somewhat below the average or what most would consider essential for success. From the standpoint of the experiments this is satisfactory, since the noteworthy establishment of plants from seed recorded later in this article can hardly be attributed to climatic conditions better than usual.

This latter statement is supported by the following details concerning the climate which the young plants had to endure during December, 1920, and January, February, and March, 1921. For these four months the total rainfall and the number of rainy days respectively were 4·14 in. and sixteen days. Month by month the record is as follows: December, 0·86 in., one rainy day; January, 0·95 in., four rainy days, with maximum of 0·34 in.; February, 0·97 in., four rainy days, with maximum of 0·62 in.; March, 1·36 in., seven rainy days, with maximum of 0·39 in. Thus there were only three showers of any moment during a period of four months. In addition, the temperature conditions were severe, as the following figures show: December, shade maximum 96°, minimum 36°, with five days over 90°, fifteen from 80° to 89°, and the remaining days from 70° to 79°; January, shade maximum 102°, minimum 33°, with ten days over 90°, fifteen from 80° to 89°, four from 70° to 79°, and one between 60° and 69°; February, shade maximum 93°, minimum 38°, with five days over 90°, eleven from 80° to 89°, five from 70° to 79°, and seven from 60° to 69°; March, shade maximum 94°, minimum 32°, with three days over 90°, seven from 80° to 89°, fifteen from 70° to 79°, and six from 60° to 69°.

The second period of rapid growth—September, October, and November, 1921—was certainly more favourable than the first period, with a rainfall of 4·40 in. in twenty-seven days. Still, as seen from the following figures, it was not by any means wet: September,

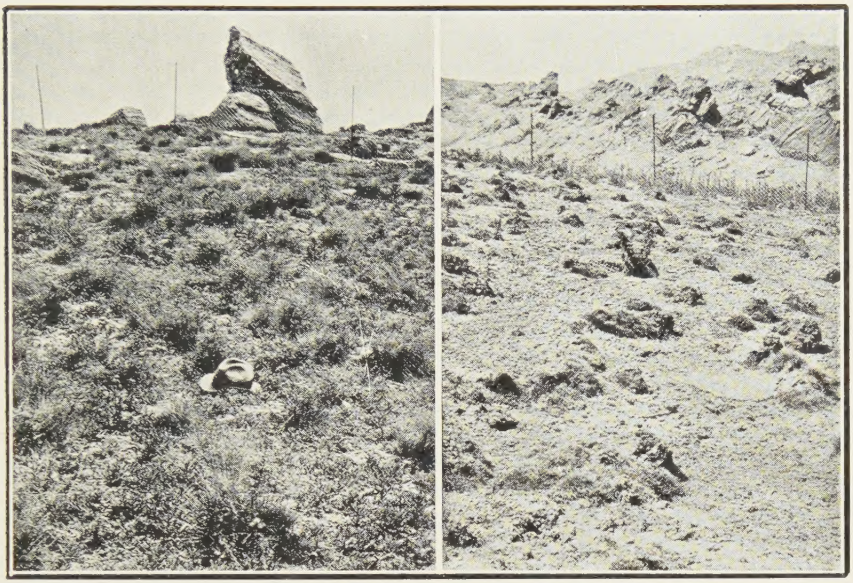

FIG. 1. ON RIGHT, PIECE OF UNFENCED GROUND OUTSIDE THE SUNNY PLOT 12, SHOWING THE CONDITION OF THIS PLOT ON 1ST FEBRUARY, 1920. ON LEFT, PORTION OF INTERIOR OF PLOT 12, SHOWING THE REGENERATION WHICH HAD OCCURRED BY 30TH NOVEMBER, 1921.

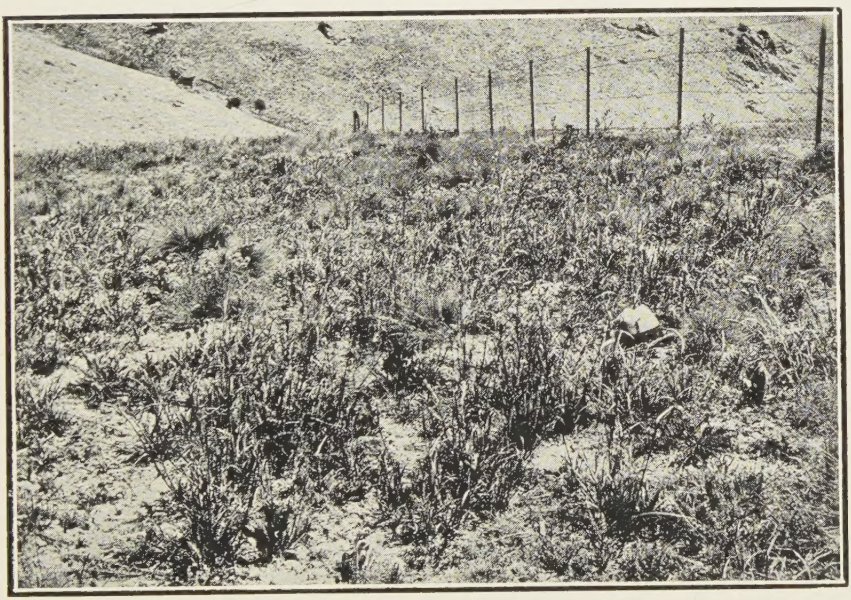

FIG. 2. PORTION OF INTERIOR OF PLOT 12, SHOWING THE GROWTH OF COCKSFOOT AND OTHER PASTURE-PLANTS FIFTEEN MONTHS AFTER THE SEPTEMBER, 1920, RAKED SOWING.

[*Photos by W. D. Reid.*

1·36 in., eight rainy days, with maximum of 0·51 in.; October, 2·44 in., fourteen rainy days, with maximum of 0·67 in.; November, 0·59 in., five rainy days, with maximum of 0·33 in.

The climate of the first four months of 1922 only concerns this article in that there was reasonable apprehension that the fine growth on many plots, as detailed later, might be injured by the coming summer, and that the general vegetation of the plots might not maintain itself in good condition ready for the spring of 1922. As it turned out, the four months' rainfall (December to March) was fairly above the average, being 7·16 in. in twenty-eight rainy days, with maxima of 0·69 in., 0·52 in., 1·08 in., and 0·28 in. respectively. As an offset to the wetter climate the heat, as usual, was severe, reaching 102° F. in January and 100° in February, while for the whole period of 121 days there were twenty-three days over 90°, forty-seven days from 80° to 89°, forty days from 70° to 79°, and eleven from 60° to 69°.

Notwithstanding the higher rainfall, this was still insufficient to really wet the ground, so that the plots maintained their state under what were really dry conditions, though there must have been some benefit gained from a period wetter than the average.

In summing up the weather conditions for the whole time of the experiments up to 30th April, 1922, it will be seen that (1) there was less than the average quantity of water in the ground at the time of the May sowing; (2) the germination of the seeds and the early establishment of the seedlings—their most critical time—took place under conditions somewhat more severe than the average; (3) the succeeding summer must have been extremely trying for the young plants; (4) the second spring was rather wetter than the average, but there were many hot days and only three showers of over ½ in. fall. On the whole, it may be accepted that the conditions during the three years—taking the first as rather unfavourable, the second as somewhat more favourable, and the third as a comparatively good year—were about the average for the locale of the experiments. But the results detailed in this paper almost wholly concern only 1920–21, so the more favourable 1922 period need not receive undue consideration.

THE EFFECT OF SPELLING.

The matter of spelling falls into the two classes of (1) land where there are still tussocks apparently dead or dying, the latter usually possessing a few leaves, generally eaten to the base, and (2) ground apparently without any trace of the original tussocks, but where a close scrutiny reveals a few widely separated very young tussocks. In addition, rocks form a haven of refuge where damaged plants persist, which, should they recover, might give rise to seedlings in their vicinity, and these, seeding in their turn, extend the range of the grass; or seeds might be brought into the plot by wind, and grasses be so established.

Plot 12, situated at a height of about 2,600 ft., lies in a belt where there are still many almost dead tussocks, their bases remaining as small hummocks (see Fig. 1, on right) with occasionally a few damaged leaves on their margins; it was, indeed, typical of many hundreds of acres, almost worthless at present, forming a narrow belt below the subalpine grass-line. This plot was enclosed from sheep and rabbits

at the end of January, 1920. On some of the moribund tussock portion no seeds were sown, so the appearance, as shown in Fig. 1 (on left), is not masked by introduced plants, but gives a true picture of the area after twenty-two months' spelling. The right side of Fig. 1, on the other hand, shows the outside of the plot, and exactly resembles the now revived portion at the time it was enclosed.

By 21st October, 1920—nine months after shutting it up—almost all the plants of tall blue-tussock which had been alive had improved, many having developed leaves on their margins from 1½ in. to 6 in. in length. Outside the plot the constant eating of the scanty leaves of the half-dead tussocks spelt for them certain death. By 25th November the tussocks had improved still more, and some were flowering. By 18th May, 1921, plants of blue-grass had developed leaves 6 in. long or more, and some of the tall blue-tussock was 6 in. through; improvement then had gone on right through the hot summer. By 5th December, 1921, the second spring had made itself felt, so that, in about twenty-two months after being enclosed, the tussock covering had been restored almost to its primitive condition (see Fig. 1, on left), and this excellent result was on a sunny face! Many plants measured 10 in. to 15 in. high and as much through; many were flowering; there was also some good blue-grass. Six months later (16th May, 1922) the improvement was still more marked.

This result of spelling plot 12 proves conclusively that the narrow belt extending far through the depleted mountains, situated between the area of total depletion and the non-depleted subalpine tussock-grassland, can be improved by even one year's spelling and almost completely restored to its primitive state in twenty-two months or less. In other words, spelling alone in one or two years, according to the stage of damage reached by the tussocks, will turn that class of almost barren country into grazing-land as good as it ever was, and will quite hinder depletion. Also, as will be seen further on, while the spelling is in progress the grassland of this belt can be greatly improved by the broadcast sowing of certain good pasture-plants.

On the badly depleted plots, both of shady and sunny faces, with the one exception of plot 3, noted below, the spelling up to May, 1922—two years and three months—has had no effect in bringing back the tussock-grassland. Where, among large rocks, there were more or less damaged tussocks, these have improved to the same degree as those of plot 12. The main effect of the spelling—and this was most marked on dark faces—was the great increase in the spring vegetation of annual plants* and in the unwonted luxuriance of the desert poa (*Poa maniototo*), the slender poa (*P. Lindsayi*), and the mats of the mountain chickweed (*Stellaria gracilenta*); various unpalatable plants also increased. No plants—tussocks or others—came into any plot by means of seeds from without. It seems almost certain that—apart from what is happening in the plots—all regeneration of tussocks hitherto noted in the depleted area of Central Otago has come about from plants already on the ground.

Plot 3 (1,300 ft. altitude), an extremely steep, stony, sunny face, stands in a category by itself, as it contained at the time of its

* See Part I of this article in *Journal* for June, 1922, pp. 327–28.

enclosure many plants, greatly eaten but full of life, of the danthonia I have hitherto called *Danthonia Buchanani** in this series of articles. These have increased considerably in size since the spelling. At the same time it must be noted that the plants of this species outside the enclosure are of fair size, the truth being probably that this grass is not relished by stock or rabbits to any marked degree. In the driest, stoniest plots no noticeable benefit has resulted from spelling.

THE RESULTS OF SOWING.

The Seeds sown.

Seeds of the species cited below were sown in the different sowings—late autumn, early spring, and early autumn. Along with each name is given the amount sown at the rate per acre (not the actual amount sown), and the percentage of germination as supplied by the Biology Section of the Department.

May, 1920, sowing: Chewings fescue (*Festuca rubra* var.), 3·2 lb., 63 per cent. germination; cocksfoot (*Dactylis glomerata*), 4·8 lb., 78 per cent.; crested dogstail (*Cynosurus cristatus*), 2·6 lb., 68 per cent.; danthonia (*Danthonia pilosa*), 3·2 lb., 26 per cent.; fiorin (*Agrostis alba*), 1·6 lb., 81 per cent.; *Lotus angustissimus*, 1·6 lb.; meadow-grass (*Poa pratensis*), 3·2 lb., 48 per cent.; tall fescue (*Festuca elatior*), 3·2 lb., 74 per cent.; Waipu brown-top (*Agrostis tenuis* var.), 1·6 lb., 81 per cent.

September, 1920, sowing: Chewings fescue, 24 lb., 63 per cent.; chicory (*Cichorium intybus*), 1 lb., 5 per cent.; cocksfoot, 3·7 lb., 78 per cent.; crested dogstail, 1·8 lb., 68 per cent.; danthonia, 2·4 lb., 26 per cent.; fiorin, 1·2 lb., 81 per cent.; *Lotus angustissimus*, 1·2 lb.; lucerne (*Medicago sativa*), 4 lb., 85 per cent.; meadow-grass, 2·4 lb., 48 per cent.; tall fescue, 2·4 lb., 74 per cent.; Waipu brown-top, 1·2 lb., 81 per cent.; yarrow (*Achillea millefolium*), 1 lb., 84 per cent.

March, 1921, sowing: Catsear (*Hypochoeris radicata*), 1·2 lb., seed bad; Chewings fescue, 2·4 lb., 79 per cent.; chicory, 1·2 lb., 51 per cent.; cocksfoot, 2·4 lb., 28 per cent.; danthonia, 1·2 lb., 45 per cent.; fiorin, 1·2 lb., 91 per cent.; *Lotus angustissimus*, 1·2 lb., 81 per cent.; lucerne, 2·4 lb., 99 per cent.; meadow-grass, 1·2 lb., 39 per cent.; rib-grass (*Plantago lanceolata*), 2·4 lb., 47 per cent.; rye-grass (*Lolium perenne*), 2·4 lb., 79 per cent.; sheep's burnet (*Poterium sanguisorba*), 2·4 lb., 60 per cent.; tall fescue, 2·4 lb., 83 per cent.; tall oat-grass (*Arrhenatherum elatius*), 1·2 lb., 44 per cent.; yarrow, 1·2 lb., 81 per cent.; Yorkshire fog (*Holcus lanatus*), 2·4 lb., 85 per cent.

* Mr. D. Petrie (the well-known authority on the New Zealand grass flora), writing to me recently, has suggested that the plant in question is a variety of *Danthonia pilosa*, and not *D. Buchanani*. In this he may be right, and I am much obliged for his calling my attention to the matter. But, so far as regrassing Central Otago is concerned, the really important point is not the name of the grass, but the fact that there is a widespread species of danthonia which still maintains itself in fair abundance in the presence of rabbits and stock. The various forms of *Danthonia pilosa*, *D. semiannularis*, and *D. Buchanani* greatly require detailed study—a matter quite as much of experiment in the garden as of field observations and dried specimens.

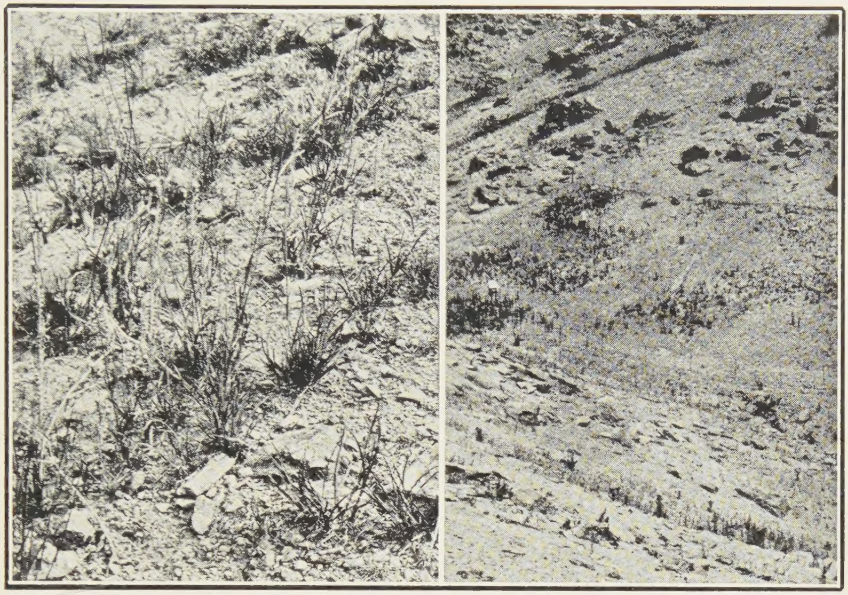

FIG. 3. ON RIGHT, PORTION OF THE SUNNY PLOT 8 AND THE SLOPES ADJACENT AT TIME OF ENCLOSING THE PLOT. ON LEFT, COCKSFOOT FIFTEEN MONTHS OLD ESTABLISHED BY THE SEPTEMBER, 1920, RAKED SOWING.

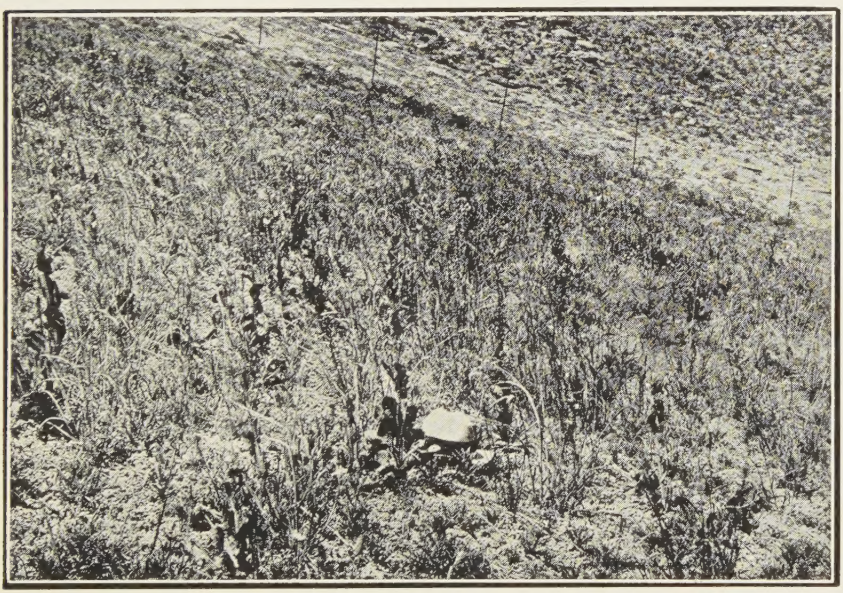

FIG. 4. PORTION OF PLOT 11, SHOWING BOTH RAKED AND BROADCAST SOWINGS OF SEPTEMBER, 1920, AFTER FIFTEEN MONTHS' GROWTH.

Note the cocksfoot, 28 in. high, and the luxuriant chicory.

[*Photos by W. D. Reid.*

The Actual Results.

Here I do not describe in full the history of development of the new vegetation—raked* and broadcast—for each plot, but am merely calling attention to the more striking points. What is really important to know is the condition early in December, 1921, of the sowings of May and September, 1920, and whether the satisfactory results remained equally satisfactory early in May, 1922, or the contrary. In other words, it is essential to learn (1) whether plants in sufficient numbers to be of practical value can be established from seed in from fifteen to eighteen months, and (2), if established, how they will be affected by another summer. Should good results still continue, then it may fairly be assumed that, in such cases, there is permanent establishment. It is also necessary to know what methods of sowing were successful, their degrees of success, and the conditions governing success or failure.

The winter examination (August, 1920) of the plots showed that the late autumn sowing of 1920 had germinated only on the sunny faces, but quite independently of the quality of the soil, or even its depth. Thus the best germination was in plot 4, certainly the worst plot of all, with its sunny aspect and shallow, stony, steep, hard soil, closely covered with scabweeds (see Fig. 2, Part II of this article, in the *Journal* for July); indeed, the broadcast sowing equalled the raked in some of the other plots. It was not until February, 1921, that the cocksfoot-plants, 6 in. high the previous October, slowly began to go back, but by May of the same year most of the plants had died. That germination on dark faces lagged behind that on sunny faces is not surprising, for the soil of the former was frozen hard for many days at a time, while that of the latter, day by day, was exposed to a hot, bright sun.

With the advent of spring the May, 1920, sowing commenced to germinate on the dark faces, and there, so far as the raked portion is concerned, the seedlings continued to make progress until there were established eventually a good many plants of various kinds.

The September, 1920, sowing germinated well by October—six weeks after sowing—on nearly all the dark and semi-dark faces, with the raked parts usually far ahead of the broadcast. In this case, too, improvement has continued uninterruptedly up to May, 1922. On sunny faces also this same sowing had germinated well by October, 1920, but, as time went on, many of the seedlings died, nor did those which survived (excluding plot 8) at all approach those of the darker faces.

The crucial examination of the plots was that of 4th and 5th December, 1921, which, in the light of the subsequent May, 1922, examination, proved the successful establishment of various plants in fair abundance. The following details should make this clear.

The Sunny Plots.—Plot 1, at about 1,100 ft. altitude, is fairly flat; its soil is a hard, silty loam covered with scabweeds. The September raked sowing had produced a good deal of lucerne (4 in. to 12 in. high), yarrow, chicory, and moderate cocksfoot, and the September broadcast sowing a fair amount of small lucerne. The May raked

* It must be remembered that the "raked" method was designed to show what harrowing—a far more efficacious method—would bring about.

sowing had established, in the best soil here and there, some stunted cocksfoot, tall fescue, and Chewings fescue. There is much country similar to this plot capable of being harrowed.

Plot 3, at about 1,100 ft. altitude, is an extremely steep, stony slope with scabweeds in places. The May raked sowing showed widely separated plants of cocksfoot (18 in. high) and tall fescue (30 in. high and more), but the broadcast had only a very few cocksfoot-plants dotted about. The September raked sowing had produced some good lucerne, and the broadcast (on worse ground), by May, 1922, had established a little good cocksfoot, tall fescue, and stunted lucerne. Over much of the ground, no matter which sowing, there is very little established.

Plot 4, at 1,400 ft. altitude, had, notwithstanding its almost impossible conditions, a little stunted cocksfoot and Chewings fescue.

Plot 5, at about 1,500 ft. altitude, with its fairly flat surface but hard, wind-swept soil, was rather better than plot 4, with stunted cocksfoot, yarrow, and Chewings fescue here and there but far apart. The value of such establishment as this on such soil depends entirely upon the time taken for sufficient increase by means of seed.

Plot 8, at about 2,000 ft. altitude, is extremely steep, and its soil stony but fairly good in places; it showed the best growth of any sunny plot. The May broadcast sowing had produced, where the conditions were best, a fine stand of grass with well-stooled cocksfoot 39 in. high, and excellent tall-fescue and Chewings fescue. The May raked sowing was on much worse ground, and its result far poorer. The September raked had cocksfoot 21 in. high (see Fig. 3, on left), good healthy lucerne, yarrow, tall fescue, chicory, and some Chewings fescue.

The Dark and Semi-dark Plots.—These plots receive a good deal of sun during the summer, but their southerly aspect leads to a maximum of moisture for the depleted ground, though even then the conditions are arid enough. The soil is usually better and much deeper than that of the sunny plots, as indicated by the presence of Californian thistle (*Cnicus arvensis*), often in abundance. I thought this plant might favour the establishment of lucerne, but the contrary has proved to be the case, the lucerne either remaining greatly stunted or having died. On the other hand, in plot 11, the thistle plot *par excellence*, all the other species which germinated have given excellent results (see Fig. 4). In these dark plots, so long as the soil is fairly good, the raked sowing, both May and September, has done well, and the broadcast has succeeded on the following plots: Plot 2 (1,150 ft. altitude), the September sowing; plot 6, (1,700 ft. altitude), both sowings; plot 7 (1,850 ft. altitude), both sowings; plot 9 (2,000 ft. altitude), both sowings. Here the September raked sowing had produced cocksfoot 30 in. and Chewings fescue 14 in. high; the presence of large rocks was beneficial. Plot 10 (2,300 ft. altitude), both sowings (see Fig. 5), except where the soil for the September raked was exceptionally bad; plot 11 (2,450 ft. altitude), both sowings, with the September raked and broadcast equally good—in fact, splendid (see Fig. 4). On the whole, the last-named plot is the best, the special feature being the large amount of luxuriant yarrow and chicory. In places the new vegetation reached far above one's knees.

Plot 12 (2,600 ft. altitude), already described in connection with spelling, stands in a class by itself, as it receives more rain and snow than any other plot; the ground is fairly level with a southerly slope. The May raked sowing had done well, with its cocksfoot and tall fescue (34 in. high); the established new plants varied in abundance from those actually touching to those 3 ft. apart; there was excellent Chewings fescue, with plants 4 in. in diameter and eight to the square yard. The May broadcast was virtually a failure. The September raked was a success (see Fig. 2), but the lucerne was sickly; there is much chicory.

The March, 1921, Sowing.—Up to May, 1922, this sowing, notwithstanding the wetter months of 1922, had not given satisfactory results, so far as could be judged. Many of the species sown had appeared. The special feature was the large amount of perennial rye-grass; sheep's burnet was more or less common on certain plots. I am giving no further details at present. Certainly, since the sowing was made on part of the ground of the May, 1920, sowing, it is not easy to tell whether any small plant may not be either a late seedling of the latter or a well-grown one of the sowing under consideration. At any rate, up to May, 1922, the March, 1921, sowing cannot be called a success.

Sowing through Trampling by Sheep.—The seed was first scattered evenly upon the ground, and then, on plot 13A (1,100 ft. altitude), 128 sheep were placed for forty-four hours and hay laid on the ground for food; on plot 13B, after the seed was broadcast, the same number of sheep were driven twice round the plot. The soil of both plots and of the contiguous control plot, 13C (which was harrowed, the seed sown broadcast, and the ground again harrowed), is extremely hard, resembles cement, is usually dust-dry, and looks as if it were impossible for any seedling to become established there. Nevertheless, the success of the forty-four hours' trampling on plot 13A is most marked, nor has the brief trampling on plot 13B been a failure; indeed, in its lucerne up to 12 in. high it has excelled the twice-harrowed plot. The progress of the new vegetation of plot 13A has been continuous although slow. Five months after the trampling there was a good even germination on nearly all the plot, while even on the hardest, cement-like surface there were four to five lucerne-plants of rather less than 1 in. in height to the square foot, and three to twelve grass-plants. By December, 1921, a good deal of the lucerne was almost as close as in a cultivated crop, and the plants on the hardest, worst ground had attained to 12 in. to 18 in. high (see Fig. 6). Where the conditions were more favourable—not taking into account the rich growth in the watercourses and in the turned-up soil of the fence-line—there was cocksfoot 27 in. and lucerne 19 in. high, and good yarrow and Chewings fescue. On the cement-like ground lucerne was the most abundant plant, but there was also yarrow, rye-grass, tall fescue, and an occasional *Lotus angustissimus*.

The control plot (13C) has not succeeded nearly as well as the sheep-trampled 13A, its lucerne, though plentiful, being quite small; there was very little cocksfoot, but more chicory in proportion, and hardly any yarrow.

The Sowings in the Open.—The various sowings made on the unfenced ground—raked, harrowed, and broadcast—at first germinated

FIG. 5. ON RIGHT, THE DEPLETED DARK FACE OF PLOT 10 AT TIME OF ENCLOSING. ON LEFT, ITS CONDITION AT THE SPOT MARKED X ON THE RIGHT-HAND PHOTO, EIGHTEEN MONTHS AFTER THE MAY, 1920, BROADCAST SOWING.

The growth seen at corner of plot in right-hand photo is Californian thistle.

FIG. 6. LUCERNE NOT QUITE FIFTEEN MONTHS OLD ESTABLISHED ON THE HARD, DRY SOIL OF PLOT 13A BY THE SHEEP-TRAMPLING METHOD.

[*Photos by W. D. Reid.*

much in the same quantity as in the adjacent plots. In some cases the plants grew well for a time. Even so late as May, 1921, there was a good deal of small lucerne outside plot 9, when the chicory and other plants had been eaten. In the Earnscleugh experimental area, where there had been at times heavy grazing, there is now no sign of any of the sowings. The harrowed sowing of March, 1921, carried out on the depleted ground of an easterly aspect above the Earnscleugh area showed quite a number of plants thirteen months later.

GENERAL CONCLUSIONS.

The following appear to be some of the conclusions which, at this stage of the experiments, may reasonably be accepted. It must be understood they refer to areas where stock and rabbits are excluded.

Regarding Spelling.

1. Where there were not already any pasture-plants in the plots, spelling for two years and two months has done nothing.

2. The belt of almost dead tall blue-tussock and blue-grass met with throughout the depleted mountains, just below the subalpine grassland, can be restored almost to its primitive condition by spelling for two years, while one year's spelling improves it considerably.

3. Where the Otago danthonia was in any plot it increased in size by spelling.

4. On dark faces spelling for one year greatly increases the amount of vernal grasses, wild geranium, and other annuals, some of which are important sheep-feed.

5. Young plants of blue-grass growing on the driest sunny faces are benefited very little indeed by two years' spelling.

6. Desert poa, slender poa, and mountain chickweed become considerably larger by spelling for one year.

7. Speaking generally, no regrassing of any moment will take place on the depleted slopes at from 1,000 ft. altitude to the belt of moribund tussocks, either on dark or sunny faces, as the effect of two years' (and probably several years') spelling unless there are living (though almost dead) tussocks on the ground. This is quite contrary to the generally accepted opinion.

Regarding Sowing.

8. In many parts of the depleted area of Central Otago, both on sunny and dark faces, good stands of pasture-plants can, in the absence of stock and rabbits, be raised in fifteen months, or even less, by sowing seeds of certain species either by the broadcast or raked methods.

9. Sowing by means of the trampling of sheep, especially if carried on for two days (but probably much less would suffice), even under extremely severe conditions, will establish various pasture-plants in satisfactory numbers.

10. (*a.*) The following species were successfully established in fifteen months by both the raked and broadcast methods: Chewings fescue, chicory, cocksfoot, lucerne, tall fescue, yarrow. (*b.*) The following additional species, sown later, have germinated more or less freely, but the plants cannot be considered established as yet: Perennial

rye-grass, sheep's burnet, subterranean clover. (*c.*) The following have failed so far, or done badly: Crested dogstail, catsear (seed bad), danthonia, fiorin, meadow-grass (in one place good), rib-grass, Waipu brown-top.

11. (*a.*) Late autumn sowing gives good germination on sunny faces, but not until spring on dark faces. (*b.*) Early spring sowing gives rapid germination, even with a rainfall somewhat below the average, and so far it has produced the best results. (*c.*) Early autumn sowing did not give good or rapid results, although it experienced a considerably higher rainfall than the other sowings; but many species germinated and withstood a subsequent hot summer.

12. Sowing on dark and semi-dark faces gives the best results for the species used in these experiments.

13. Good results may follow sowing on sunny faces, unless the soil conditions are of the worst kind.

14. In all cases, the better the soil the better the results; so that with the best soil there is little to choose between the raked and broadcast areas.

15. Lucerne cannot be raised successfully among Californian thistle under the conditions of these experiments.

16. In a majority of the plots the lucerne eventually became more or less yellow, but in other plots it was green and healthy.

17. Seeds did not germinate on scabweed in any of the plots.

18. The successful establishment of plants increases with increasing altitude, at any rate up to 3,000 ft.

19. Up to the present no species coming from seeds sown in the open (outside the plots) have become established, but lucerne persisted, and grew for a considerable time.

20. In one plot—the only one tried—plants have been established on very poor ground by means of harrowing.

Miscellaneous.

21. The following species, originally planted at the end of September, 1920, are well established on the dark and semi-dark plots (but not all on the same plot): *Agrostis* sp., catsear, Chewings fescue, cocksfoot, blue-grass,* lucerne, meadow-grass, *Poa laxa** (generally luxuriant), red clover,* rye-grass (perennial), *Sonchus arvensis*,* subterranean clover, sweet vernal,* tall blue-tussock,* tall oat-grass,* twitch (*Agropyron repens**), white clover* (in one place), yarrow, Yorkshire fog; and trees—insignis pine, ponderosa pine.*

22. Seeds of insignis pine dibbled into hard, extremely dry ground in March, 1921, were a long time before germinating, but in May, 1922, on plot 1 there were many healthy young plants.

These conclusions show that though in a few cases definite answers have been given by the experiments to important questions, much is only half-answered at best; so that a great deal requires to be ascertained before a payable method of regrassing can be in sight. The coming season—even the next examination of the plots in a month or two from now—should give some information concerning that most important point of all—namely, to what extent the plants now established will increase their area by means of seed. There are also many species

* Not used in any of the sowings.

yet to be experimented with. The failure of certain species already used is, in some cases, to be attributed to poor seed, as in the case of that highly palatable plant, catsear.

Finally, it seems safe to assert that, in the brief time of the experiments, some definite knowledge of importance has been gained, and that the solution of the difficult regrassing problem is not so hopeless as it seemed. Farther than that, however good some of the results may be, it is not yet safe to go.

Corrections.—(1.) In Part II of this article, published in the July *Journal*, on page 8, it is stated that "In every case the north-west corner-post was marked A." This, however, is not the case for plots 8, 9, 10, and 12, where it was the north-east corner-post which was so marked. (2.) Fig. 4, page 9, in the same part of the article, is not plot 6, but plot 7.

BOT-FLIES IN NEW ZEALAND.

DAVID MILLER, F.E.S., Entomologist, Biological Laboratory, Wellington.

Bot-flies belong to the group of two-winged insects known as Diptera, and owing to their larvæ being parasites of mammals many of them are of considerable economic importance. There are no species peculiar to New Zealand, all those now established here having been introduced. They are not difficult to distinguish from other flies; the head is comparatively large and the eyes small in proportion; the lower part of the head is somewhat swollen, and in such species as occur in the Dominion there is a small pit representing the vestigial mouth in the centre of this swelling; the body in some species is clothed with hair.

The species established in this country are of European origin, and have been carried with the animals they infest to many other parts of the world. They are the sheep nasal bot (*Oestrus ovis* Linn.), the common horse-bot (*Gastrophilus intestinalis* (*equi*) de Geer.), and the throat horse-bot (*G. nasalis* Linn.). Another species, the ox warble-bot (*Hypoderma bovis*), has not yet become established in New Zealand; about thirty years ago its larvæ were found under the skin of cattle in the Catlin's district, but there has been no record of it since; cattle in quarantine, however, are sometimes found to be infested.

In New Zealand the actual loss due to bot-flies is apparently negligible, though there can be no doubt that a badly infested animal must suffer considerably from the presence of the parasites. In Europe, however, the injury by bot-flies is of a more serious nature, and instances of death occur as a result.

SHEEP NASAL BOT-FLY.

The sheep nasal bot-fly (*O. ovis* Linn.) is fairly common in many parts of the Dominion. The adult (Fig. 1) measures just under $\frac{1}{2}$ in. in length; the face is pale-yellowish-white in colour, while the surface of the thorax and top of the head are covered by numerous small black warts; the abdomen is blackish and mottled with silvery grey.

This fly is very swift on the wing, being most active during sunny weather; it responds rapidly to a fall in temperature, when it seeks some shelter. As the female darts swiftly past a sheep's head she ejects on the animal's nostril a globule of fluid containing a young maggot; the legless maggot works its way up into the frontal sinuses, where it remains until fully grown, when it passes down to the nostril and is sneezed or drops out. The mature maggot is stout and fleshy (Fig. 2), measuring under 1 in. long; though legless it is fairly active, progressing by means of minute spines arranged in patches on the under-side of the body. On leaving the sheep it burrows under some shelter on the ground, and there transforms to the pupa from which the adult insect ultimately emerges. In some cases the horns of sheep are infested by the larvæ of the fly.

FIGS. 1 AND 2. ADULT SHEEP NASAL BOT-FLY AND LARVA. × 2.

In New Zealand no attempt is made to control the sheep nasal bot-fly, since the damage done by it is practically nil. In any case no very satisfactory control measures are known, and if a campaign were necessary it should be directed against the adult fly, taking advantage of its habit of becoming sluggish and sheltering on any prominent object in the early morning and evening. The application of deterrent substances to the nostrils of the sheep in order to ward off the fly is useless, since the latter does not land on the nostrils to deposit eggs. Equally useless is the method of injecting insecticides into the nostrils, as such substances not only serve to drive the maggot farther into the frontal sinuses, but also are a considerable irritation to the sheep. The maggot does not enter the brain-cavity, as is frequently asserted; if it is found in such a position its presence is due to accident during the process of opening up the skull.

HORSE BOT-FLIES.*

The horse bot-flies, and their yellowish eggs attached to the hair of horses, are well known to every farmer. Of the various species the two which occur in New Zealand are distinct not only in their method of placing the eggs, but also in the character of the adults and larvæ. The adults agree in general form, the thorax being clothed with a dense pile of yellowish or orange-red hair, and the abdomen of the

*The writer is indebted to Mr. J. E. Holland, of Avoca Valley, Canterbury, for valuable information supplied regarding the occurrence of horse bot-flies in his district.

FIG. 3. FEMALE HORSE BOT-FLY IN CHARACTERISTIC ATTITUDE FOR OVIPOSITING. ENLARGED.

[*Original.*

FIG. 4 (LEFT). GASTROPHILUS INTESTINALIS—ADULT FEMALE. × 2.

FIG. 5 (RIGHT). GASTROPHILUS NASALIS—ADULT FEMALE. × 2½.

[*After Hawden and Cameron.*

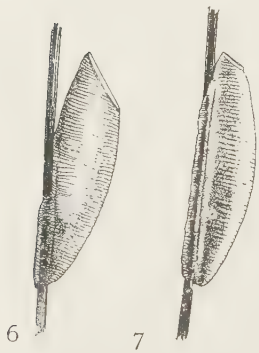

FIG. 6. GASTROPHILUS INTESTINALIS—EGG. × 25.

FIG. 7. GASTROPHILUS NASALIS—EGG. × 25.

FIG. 8. GASTROPHILUS INTESTINALIS—LARVA. × 2.

FIG. 9. GASTROPHILUS NASALIS—LARVA. × 2.

[*After Dove.*

female, which is long and pointed, being carried curved beneath the body (Fig. 3). When ovipositing the female darts rapidly in towards the horse, and from the end of the abdomen, which projects beneath the head, ejects an egg, at the same time fastening it to a hair of the animal.

The common horse-bot (*G. intestinalis*) is somewhat the larger species (Fig. 4), and is distinguished by a dark cloud across the middle of each wing; the abdomen is reddish-brown with a blackish tip, while the delicate covering of hair is rather whitish at the base in some specimens. The throat horse-bot (*G. nasalis*) is rather smaller (Fig. 5), and the wings are not clouded across the middle; the abdomen is black with whitish pile at the base and across the middle towards the end.

The female of *G. intestinalis* deposits her eggs preferably on the forelegs of the horse, frequently on the shoulders and mane, and sometimes on the flanks and hind legs. Each egg is attached in a manner peculiar to the species; about two-thirds of the egg is attached to a hair, usually towards the end of the latter, by means of a pair of "flaps" which encircle the hair (Fig. 6). The eggs of *G. nasalis* are most frequently laid beneath the jaw; each egg is attached nearer the base of a hair, and the supporting flaps of the egg extend practically the full length of the latter (Fig. 7). The end of the egg of *G. nasalis* is more pointed than that of *G. intestinalis*.

The eggs of *G. intestinalis*, being laid within reach of the horse's mouth, hatch when moistened by the animal, and the larvæ thus gain entrance to the mouth and thence to the digestive system, where they attach themselves by means of the pair of stout claws situated at the head end of each larva. The body-segments are encircled by a double row of short spines (Fig. 8) in the case of *G. intestinalis*, but the segment-spines of *G. nasalis* are in a single row (Fig. 9). The manner in which the larvæ of *G. nasalis* enter the alimentary system of the horse is not thoroughly understood. The eggs being laid, as a rule, beneath the jaws are out of reach of the animal's mouth, and it is thought by some observers that the larvæ hatch and burrow into the skin, but there is nothing definite to show that this is so. The larvæ of *G. nasalis* are found attached in the pharynx as well as in the stomach.

When the larvæ are fully developed they are ejected with the excrement and seek some sheltered place in the ground, when they pupate. The pupation period of *G. intestinalis* lasts from six to nine weeks, and that of *G. nasalis* from three to eight weeks, when the adults emerge.

Practically every horse is infested with bots, but in most cases their presence apparently does not inconvenience the animal, except when the latter happens to be in a low condition. In treatment carbon bisulphide has been found useful, this being administered in four doses, each in the form of a 10-gramme capsule at one-hour intervals before the animal is fed. The day before dosing with carbon bisulphide a purgative of 20 grammes of extract of aloes is administered. As a protection against *G. nasalis* a piece of sacking or other material is usually tied beneath the jaws of the horse. It is more difficult, however, to prevent *G. intestinalis* ovipositing on the legs and shoulders, &c., but repellent mixtures applied where the eggs are laid would tend to keep off the flies.

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POLLINATION IN ORCHARDS.

SOME RECENT INVESTIGATIONS.

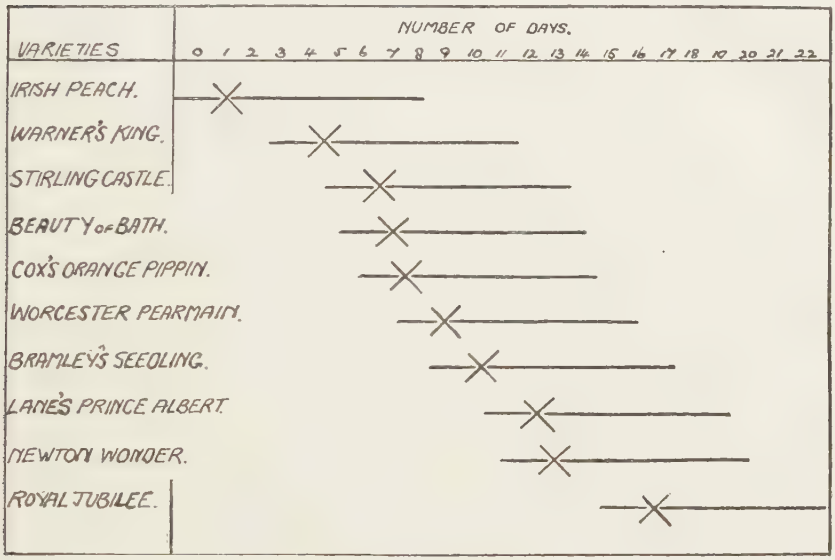
Horticulture Division.

THE pollination of fruit-trees is a matter of increasing importance to commercial orchardists. In former times when a comparatively large number of varieties was planted in an orchard this question was hardly thought of. In such cases interpollination was doubtless secured by the number of different varieties grown, and when a few trees failed to produce a crop it was attributed to some cause other than lack of fertile pollen. The fact that interpollination was taking place all the time was, of course, not apparent. Cross-pollination affects the seeds of the plant, not the seed-envelope, therefore the appearance of the fruit is not altered. The fact that fruits do not come true from seed has generally been attributed to their hybrid character, whereas it is in all probability due to cross-fertilization. When, however, it became the rule to plant large blocks of one or a few varieties, it soon became evident that early-formed ideas were largely wrong.

During recent years a number of investigators have been working on the pollination question. The subject is a very difficult one to investigate; special means and great care and patience are necessary. The most extensive and carefully carried out investigations appear to have been made in England, while a great amount of work on the same subject has also been done in America. The difficulty of the subject is shown by the very contradictory results experienced. In some cases, for instance, trees in the open air self-pollinated by hand set no fruit, whereas the same varieties self-pollinated in an orchard house set a few fruits. The condition of the tree affects its ability to set fruit; weather conditions also exert an influence. A number of facts have been ascertained, however, although a great amount of work yet remains to be done. A variety may be fully fertile to its own pollen, weakly so, or quite sterile. A variety may be quite fertile yet fail to produce a full crop, or at least a full crop regularly. The

reason for this is not a matter of great consequence to an orchardist, the ascertained fact being sufficient. The pear Williams Bon Chrétien (Bartlett) furnishes a case of this kind. This variety is quite self-fertile, yet it has been found in America that, though when self-pollinated it produces good crops, much heavier crops and greater regularity in bearing are secured by interpollination. American blocks of Bartlett have in consequence been rearranged. This effect, it is claimed, is common to most fruit varieties, self-fertile varieties being strengthened by introduced pollen from other varieties.

Another subject that has been investigated is regarding the agents which disperse pollen. A. N. Rawes and G. Fox Wilson, attached to the Wisley Laboratory of the English Royal Horticultural Society,



POLLINATION CHART.

The lines indicate the average period of blooming—nine days. The crosses indicate full bloom.

have thrown light on this subject. They show that the belief that wind is an agent is wrong—that it does not and cannot have any effect on the dispersal of pollen, because the pollen of fruit-trees is sticky. Slips of glass smeared with glycerine were suspended at varying distances from apples, pears, and plums in full bloom. In very few cases were pollen-grains of fruit-trees found upon them, and in such it was in clusters of several grains, which had evidently been left there by insects alighting on the slips, as in some cases legs were left behind as well. Hive-bees are commonly credited with being the most important pollen-carriers, but in the Wisley observations this was not the case. During dull and stormy weather hive-bees were not seen, but numbers of other insects were, including humble-bees, syrphus flies, hover-flies, midges, and small two-winged flies.

So far as at present known any fruit-tree variety will serve as a pollinator for any other, provided it be in flower at the same time. The case is usually stated as "almost any other," which appears to mean that investigations have not gone far enough to permit a more positive statement. Varieties rarely begin to open flowers on the same day, and, of course, the dates are different in various districts. When selecting interpollinating varieties the dates of flowering in one place must be known. The dates may vary slightly in different years, but not much, and each variety will vary to this slight extent. If transplanted to another district the same sequence would be maintained. It is well known that individual blossoms on a tree do not all open at the same time. The observers before mentioned state that the average life of individual blossoms is about a week, and the average blossoming-period about eighteen days, which coincides very nearly with observations in this country. For really effective cross-pollination between any two varieties the time of flowering—from two days before full bloom until seven days after full bloom—should overlap. This means that the later variety should begin to open its flowers not later than two days before the earlier variety reaches full bloom.

The accompanying chart is reproduced from an article in the *Journal of the Royal Horticultural Society* by Messrs. Rawes and Wilson. The crosses show the time at which each variety may be expected to come into full flower in relation to any other, the days' difference being noted on the top line; the lines opposite each variety represent their effective flowering-period—two days before full bloom and seven days after. From this chart it may be seen that if two varieties, such as Warner's King and Newton Wonder, were planted together, by the time the Newton's were in full flower the blossoms of the Warner's would be some nine days past full bloom, and although even then cross-pollination would take place to some extent, it would not be so effective nor likely to induce such good settings of fruit as if a row or two of Worcester's, Cox's, or Bramley's were interplanted, which would ensure the effective cross-pollination of both. Similarly, any of the first five varieties on the chart would be of little use as cross-pollinators for Royal Jubilee, or *vice versa*.

It is inadvisable to plant larger blocks of any variety than four rows without another variety to provide pollen, since in larger blocks than this it is possible that the centre trees may be insufficiently cross-pollinated, especially if high winds prevail during the time of flowering, when wild insects and bees prefer to confine their attentions to small areas. Where efficient means for the cross-pollination of fruits do not at present exist, the trees in every fourth row or so should be top-worked with a variety or varieties capable of effecting the desired purpose.

Basic Superphosphate.—The advantage of the dicalcium phosphate which results from the reversion of superphosphate effected by the addition of lime is that it is not acid like super, and does not in contact with the fine soil-roots of plants tend to destroy them. It is, moreover, more soluble in soil-water than the tricalcic phosphate, and is in a very much more finely divided state than finely ground raw rock phosphate. The agricultural value of dicalcic phosphate is therefore higher than that of the tricalcic phosphate, but lower than that of superphosphate.

THE BREEDING-EWES.

BUILDING UP A FLOCK.

J. G. COOK, Wool Instructor, Live-stock Division.

NEEDLESS to say, the ewes have a most important part in the building-up of a flock to the ideal aimed at by the breeder, and it is essential that they should be carefully selected to ensure their possession in a pronounced form of the requisite qualities. Leading characteristics which a ewe should possess are constitution, trueness to type, vitality, fertility, and good bone and conformation. The wool should be of as even a quality as it is possible to get it, and should possess soundness, character, density, length, and sufficiency of yolk.

The following are detailed points of a good all-round ewe: A well-shaped head of a size in proportion to the body; forehead broad and full; nice silky ears of a length and width according to breed; crest well arched; face of a fair length; orbits nice and full; jaws strong and with no defects; nostrils large; a well-rounded muzzle; teeth level and strong, the cutting-teeth in the lower jaw fitting against the cartilaginous pad in the top jaw; neck of fair length to enable the animal to feed comfortably, well set in at the shoulders, and tapering to the head; withers full and rounded; back of fair length and width, ribs nicely sprung from the backbone; hips wide and full, to avoid difficulties in lambing; hindquarters of a good depth and width; a good arch in the crutch; shoulders full and deep, with a good width between; a good wide framework, to give plenty of room inside for the vital organs to do their work properly. These points give a well-balanced body. Then strong serviceable legs are required, with wide knees, strong springy pasterns, and good hocks, fetlocks, and hoofs.

The wool grown by the animal should be of as even a quality all over as it is possible to get it, and the waves or crimp in the fibre should be even and extend from base to tip. This class of wool has elasticity, pliability, and softness, and is said to possess "character." There must also be density, to give weight to the fleece and due resistance to the weather elements. An open, light fleece suffers considerable damage from this cause. The wool should be long enough for combing purposes, and sound in order to stand tension when being combed. Such wool, of robust growth and good yolk, gives the perfect fleece.

Constitution is important, because it is the foundation of the animal. Where both ewes and rams are selected with proper regard to strong robust constitutions, this characteristic is disseminated throughout the flock, and with fair treatment such animals will produce strong, healthy progeny. With sound vitality the ewe can stand reverses, but must be looked after, especially during the last month of gestation and at lambing-time. Fertility is, of course, essential; any young ewe which has been out with the ram and failed to produce should be tagged and watched next season, when if still unproductive she should be sold to the butcher.

A ewe with any of the following faults should be culled out: Broken-mouthed, faulty constitution, too narrow in the head, squeezed pinched nose, defective jaws, scraggy neck, weak shoulders, razor back, soft springless ribs, poor narrow hindquarters, thin bone, faulty udder, defective knees, hocks, or fetlocks, and wool of a very uneven quality.

In building up a flock the ewes should always be purchased first, and an endeavour made to secure a line from a local sheep-breeder; but if this cannot be done, then other steps must be taken. It is wise not to bargain unduly over the price required by the vendor, bearing in mind the time and work involved in breeding up a uniform flock, and that by starting in this way the purchaser saves several years of patient work in selection, mating, breeding, lambing, feeding, and culling, besides many disappointments. When it is possible to secure an even line at the start it should be done. Success or failure will then depend entirely on the farmer's own ability in selecting the rams required, mating them with the ewes, the feeding of the flock, attention to the ewes during the gestation period and lambing-time, the treatment immediately after lambing, then the culling-out of aged and defective ewes and fattening and selling them for mutton. If it is not possible to privately buy a suitable line of ewes from a breeder, and it becomes necessary to purchase them at the saleyards, the buyer should go to the yards early, so as to have plenty of time to go through the lines to be submitted for sale and inspect them all thoroughly. Naturally, there will be some lines which will not do, because not suited to the particular class of country for which they are required. When making this examination the buyer should keep a note of any pens which at first glance seem to meet requirements, and then go over these particular pens again and examine each lot more critically, paying attention to the points already mentioned.

It is generally advisable when purchasing at saleyards to buy a little more than the number actually required, because after the sheep have been brought on to the farm there is practically always some culling-out to do. This should be attended to without undue delay, driving the ewes into the yards, closing all outside gates, and partly filling the check-pen. Assuming that a number of different pens have been bought, the sheep should be classified into three lines: (1) Those carrying fleeces uniformly fine throughout; (2) those with fleeces uniformly coarse throughout; (3) rejects, which will include any having faulty conformation, or which are too old, or any on which the wool is too uneven in quality—that is, fine on the fore part and running to hair on the hindquarters (a very serious fault). Any animals whose wool is mushy and open should also be discarded. Those in the first category should be marked with, say, blue raddle, those in the second with red, and the rejects left unmarked. Each lot can then be drafted off separately, a further lot of sheep placed in the check-pen, the process repeated, and so on until the flock is finished.

Next comes the branding. The fine-woolled ewes can be branded on or about the wither, the coarse-woolled ones on the rump, and the rejects on the back, a tally being kept of the number of each lot. The rejects should be fattened as speedily as is convenient and sold for mutton. They will then be out of the way for all time, and not transmit their faults to progeny in the hands of some inexperienced farmer who might have purchased them for breeding purposes.

When the ewes have been classed and drafted one is in a position to know the class and number of rams required. For instance, in the case of a purchase of 500 ewes it might work out somewhat as follows: 60 per cent. of fine-woolled, 300; 33 per cent. coarse- or strong-woolled, 165; 7 per cent. rejects, 35: total, 500. Here are two lines of ewes suitable for breeding purposes, and with the object of breeding to one uniform line nine strong- or coarse-woolled rams and five fine-woolled rams should be purchased. In deciding the number of rams to be used it is advisable to consider the class of country and the size of the paddocks the ewes will be on during the mating season, and to allow a few extra in case of accidents.

Just before the mating season the farmer should go round the fences where the sheep will be running during that period. Faulty posts or stakes should be replaced, and all wires tightened up, so that sheep cannot get out. Two paddocks will be required. If all the ewes have been running together they should be drafted off to their respective lots, and the fine-woolled rams turned in with the strong- or coarse-woolled ewes, and the coarse- or strong-woolled rams with the fine-woolled ewes. This is the best way to breed to one line on the farm when unable to purchase a straight line from a breeder. It is always to the advantage of the small sheep-farmer to breed only one line, as the wool clip will then be more even and bring better prices.

Passing on to the period when the lambs have became hoggets, shearing-time affords another good opportunity for improving the breeding-flock, as the sheep are then carrying their full fleece. The ewe hoggets should be gone over carefully and any with a fleece of uneven quality culled. The culling should be strict, and any animal that there is any doubt about should be put out. Mark the culls with a raddle mark on the face; then when they have been shorn and come to the branding-pen, put the brand on a different part of the back from those that are being retained. When the time arrives for putting these young ewes with the rams, separate the fine-woolled from the strong- or coarse-woolled, and mate them with the rams of the opposite characteristics, in the same way as was done with the older ewes the previous year. Ewes should be at least eighteen months old before being mated with the ram; it is very rarely that a young ewe has twin lambs. This second culling will be practically the last required, and, except in the case of an odd animal or two that may have thrown back and will be required to be discarded, culling for age alone should be necessary in the future.

New Zealand is fortunate in having had and having in the sheep industry a number of great breeders, and it is largely to the work of these men that the country owes its success in the industry. By skill and untiring perseverance they have developed their flocks to a high standard of excellence. From them the ordinary farmer can procure stud animals with which, by careful selection and mating, he can build up a first-class flock or improve his existing one. Every enthusiastic sheep-breeder has in his mind's eye the type of sheep which he considers perfect. In spite of occasional set-backs and disappointments he never loses his enthusiasm to produce this type, and having once attained it he will endeavour, by continual culling of any individuals showing faults, to prevent any deterioration.

The ram will be dealt with specially in a future article.

COSTING OF CROPS AT THE MOA SEED FARM.

J. W. HADFIELD, Manager, Moa Seed Farm, Dumbarton, Otago.

(W. F. Marsh, Recorder.)

COSTING accounts have been kept on the Moa Seed Farm for the past two seasons. This work was necessary in the initial stages of the farm owing to many of the seed crops having been rarely, if ever, grown in New Zealand. These notes present the results of the work in so far as it concerns those crops more commonly grown by farmers.

METHOD OF OBTAINING RECORDS.

Labour.—Every man on the farm hands in a weekly time-sheet showing the distribution of his labour during the week. The form provided has a space against each day of the week, showing the paddock, nature of work, and number of hours devoted to this work. These sheets are collected on Mondays, and the previous week's work is then tabulated against each paddock. At the end of a four-weekly period the labour expended upon each paddock or crop is converted into cash and debited to the respective accounts. To the actual wages paid is added an additional £1 per week per man, which covers the cost of board.

Team Work.—The farm foreman keeps in a diary a daily record of the distribution of horses over the farm. This also is tabulated weekly and charged up against each paddock monthly in terms of "horse-hours"—that is, a four-horse team working eight hours performs thirty-two horse-hours. The actual cost per horse-hour is arrived at by taking into consideration the cost of feed consumed, rent of stables, and interest and depreciation on horses and harness to the extent of 16 per cent. per annum. To simplify the work interest and depreciation on all farm implements are included in an overhead charge at per acre of cultivated ground.

The cost of feed is arrived at from a record of feed consumed, which is kept in the stables. Chaff and oats produced on the farm are charged up at a price which represents the actual cost of production. From these figures it is then possible to determine the amount to debit each account with in respect to horse-labour. A separate monthly account is kept, and the cost per horse-hour is determined by dividing the total cost of the horses for the month by the number of horse-hours worked during the same period. A typical statement may be given as follows :—

Horse Account, Period ending 27th August, 1921.

	£ s. d.		£ s. d.
To 3 tons chaff, at £3 4s. ..	9 12 0	By 1,227 horse-hours, at 4s. 10d.	20 19 4
36 bushels oats, at 2s. 8d.	4 16 0		
Interest and depreciation	5 18 0		
Rent, &c.	0 13 4		
	£20 19 4		£20 19 4

It is very evident that the cost per horse-hour will vary from month to month. On the one hand, the greater the amount of work performed by the horse in any one period the lower the cost per horse-hour. On the other hand, horses working full time consume more feed, and their gross cost is higher in a busy period than in a slack one. Owing partly, however, to the charge for interest and depreciation being constant from one period to the next, the final result is that the cost per horse-hour is lowest when the number of horse-hours worked is highest.

The following figures show the variation in the cost per horse-hour as affected by the number of hours worked. It must be explained, however, that there was a drop in the price of feed during October, while in November half the working-horses were turned out to graze.

Monthly Period ending	Number of Horse-hours worked.	Cost per Horse-hour, in Pence.
30th July, 1921	1,197	4·68
27th August, 1921	1,227	4·10
24th September, 1921	1,720	3·22
22nd October, 1921	1,108	4·14
19th November, 1921	935	3·47
17th December, 1921..	579	5·09
14th January, 1922	449	7·03
11th February, 1922	1,026	3·16
11th March, 1922	661	5·08

Taking the full period, the average cost per horse-hour was 4·4d.

Rent.—This has been fixed for each paddock by the Land Board, and becomes a direct charge against each crop, extending from one harvest to the next.

Seed and Manure.—These are charged direct to the crop. Seed produced on the farm the previous season is charged at the cost of production ; otherwise, seed and manures are charged at actual cost delivered on the farm.

Overhead Charges.—This account includes also interest and depreciation on machinery and implements, and is charged at a rate per acre to the respective crops.

The cost of individual operations in cropping varies considerably, and misleading figures creep in, due to factors other than variation that must result from delay and loss during unfavourable weather. One of these is apparent from the figures showing cost per horse-hour. It would be reasonable to suppose that a crop the land for which is prepared during a slack period—as, for example, between seeding and harvest—should be very economically grown, since otherwise the horses would be idle ; but the very fact that it is a slack period renders the cost per horse-hour high, and the crop is penalized to this extent. During a wet spell the horses are idle, but any paddock sufficiently dry to enable a little work to be carried out, or any other work about the farm that may be done during that time to fill the gap, is penalized by having a high rate of pay for horses. The following figures of costs are, however, those actually worked out on the farm last season, and, when all objections are raised, are not likely to be far from correct :—

FIG. 1. HARVESTING VELVET WHEAT IN PADDOCK NO. 6 AT THE MOA SEED FARM.

The enormous yield of straw of this crop increased the cost of threshing 100 per cent. above that of an average crop of wheat in paddock No. 1.

FIG. 2. CROP OF ITALIAN RYE-GRASS AND COW-GRASS IN PADDOCK NO. 7 (SEEDING 20 LB. AND 8 LB. RESPECTIVELY PER ACRE).

In spite of a loss of fully 20 lb. of seed per acre owing to constant rain during harvest the first seed crop of rye-grass has almost cleared expenses on this paddock. A fine stand of cow-grass is left, which will yield seed for some years.

Ploughing—Double furrow, four or five horses, average 9s. 6d. per acre.

Harrowing—Four horses, single stroke, average 1s. per acre.

Single disking—Four or five horses, average 2s. 3d. per acre.

Sowing—Four horses, 13-coulter drill, average 3s. 5d. per acre. (Slightly less with no manure.)

Binder cutting—Three horses, from 2s. 7d. per acre in a very light crop of oats yielding 1 ton of chaff per acre to 4s. 10d. in a badly lodged crop of barley, and 4s. 10d. in a heavy crop of oats on a sideland yielding over 3 tons of chaff per acre (see Fig. 3). Average over ten crops, 3s. 4d.

REVIEW OF CROPS.

In this connection it will be sufficient to review some of the more commonly grown crops, and these are tabulated on page 160. Such crops as radish, beans, carrot, parsnip, beet, mangold, lettuce, flowers, &c., grown here for seed are not included, partly because the returns are not complete and partly because they are of no general interest. The final calculation with reference to cost per bushel or per ton, shown in the table, does not include any freight charges, since the cost of placing farm-produce at the railway varies to such an extent. For the Moa Farm it amounts to £1 8s. per ton.

These tabulated results can by further analysis be used to bring out many points of interest. The cost of threshing, for example, shows a good deal of variation, and when brought to the cost per bushel gives the following figures: Wheat, 6·6d.*; oats, 3·8d.; skinless barley, 5·6d.; garden peas (William Hurst and Alderman), 18·7d. Without some knowledge of the value of the produce this comparison is misleading, and it would be more fair to make the comparison upon a unit of value (the shilling) rather than upon a unit of weight (the bushel). By dividing the cost of threshing by the value of the produce in shillings a figure is obtained which shows what might be termed the cost of threshing one shilling's worth of produce. By this means the following comparisons are found: Wheat, 1·1d.; oats, 1·4d.; skinless barley, 1·1d.; peas, 2·3d. This places the cost of threshing peas in a rather more favourable light, but it still remains high, being nearly double the cost of that of cereal crops. The cost has, in fact, rendered it necessary on this farm to adopt some other method of threshing peas in place of the large combine.

Individual Crop Accounts.

In this connection, in view of the tabulated returns, it will be sufficient to detail the crop accounts of a few typical examples.

Paddock No. 16, of 35 acres, was sown down with three crops, and received the same cultivation throughout till the time of sowing. An account is therefore kept of No. 16 up to this time, and the cost allotted proportionally to the crops grown in the paddock.

* The Velvet wheat in paddock No. 6 (Fig. 1) is purposely left out. The cost of threshing this crop was nearly double that of No. 1, on account of the abnormally heavy yield of straw.

Paddock No. 16, 36 Acres.

	£	s.	d.		£	s.	d.
To Spreading straw ..	2	16	11	By Hero oats, 20 acres ..	32	13	11
First ploughing (skim) ..	18	16	3	William Hurst peas, 7 acres	11	9	0
Single disking	3	18	8	Golden vetches, 8 acres..	13	1	9
Second ploughing (deep)..	25	5	4				
Single harrow	1	10	4				
Disking	3	7	3				
Harrowing	1	9	11				
	£57	4	8		£57	4	8

Hero Oats, 20 Acres (No. 16).

	£	s.	d.		£	s.	d.
To Proportion of cultivation	32	13	11	By 21 tons chaff, at £4 15s...	99	15	0
Sowing	3	1	8	955 bushels oats, at 2s. 6d.	119	7	6
Harrowing	1	7	11	12 loads straw, at 5s. ..	3	0	0
Carting seed and manure	0	3	2				
Manure	10	10	10				
Seed	4	2	4				
Harrowing crop ..	0	12	4				
Cutting with binder ..	4	4	10				
Binder-twine	3	10	0				
Stooking	2	13	11				
Leading in	14	8	1				
Rent	21	10	0				
Overhead charges ..	6	10	0				
Threshing, 13 acres ..	14	19	2				
Grain-sacks, depreciation	0	19	3				
Chaff-cutting, 7 acres ..	13	4	8				
Depreciation on chaff-sacks	4	10	0				
Balance	83	0	5				
	£222	2	6		£222	2	6

NOTE.—This produce is all sold locally at the prices stated and delivered on the farm. There are, therefore, no charges for cartage, railage, commission, &c.

William Hurst Peas, 7 Acres (No. 16).

	£	s.	d.		£	s.	d.
To Proportion of cultivation	11	9	0	By Sale of 260 bushels peas..	109	15	7
Sowing	1	15	0	Value of seed on hand ..	6	13	4
Harrowing	0	9	5	Sale of straw	1	11	3
Rolling	0	16	3				
Rogueing	0	9	5				
Seed	13	9	7				
Manure	5	5	5				
Cutting with mower ..	2	2	0				
Raking	0	14	11				
Cocking	1	7	3				
Leading in	8	15	3				
Opening and restacking ..	3	1	9				
Rent	7	10	6				
Overhead charges ..	2	5	6				
Threshing	25	4	8				
Sacks, depreciation ..	0	7	0				
Cartage	8	15	0				
Balance	24	3	1				
	£118	0	2		£118	0	2

Golden Vetches (sown with Rye-corn), 8 Acres (No. 16).

	£	s.	d.		£	s.	d.
To Proportion of cultivation	13	1	9	By Sale of 188 bushels vetches	112	16	0
Sowing	1	11	11	32 bushels rye-corn at 4s. 6d.	7	4	0
Harrowing	0	7	0	Value of seed on hand	1	10	0
Rolling	0	19	10	Sale of straw	4	7	6
Vetch-seed	8	15	6				
Rye-corn	1	1	0				
Manure	3	16	8				
Cutting	2	17	10				
Raking	0	4	5				
Cocking	4	13	5				
Leading in	13	11	7				
Opening up and restacking	3	5	2				
Rent	8	12	0				
Overhead charges	2	12	0				
Threshing	25	4	8				
Loss on sacks	0	4	8				
Cartage	7	2	1				
Balance	27	16	0				
	£125	17	6		£125	17	6

Wheat, 10 Acres (Paddock No. 1).

	£	s.	d.		£	s.	d.
To Ploughing	5	15	5	By Sale of—			
Disking, harrowing, and rolling	8	19	2	Milling-wheat	59	12	3
Sowing	1	12	11	Fowl-wheat	23	0	0
Seed	13	16	10	Seed-wheat	24	14	10
Manure	5	5	5	Straw	2	15	0
Cutting with binder	2	2	6				
Twine	1	15	0				
Stooking	1	15	0				
Leading in	5	1	3				
Threshing	10	0	3				
Loss on sacks	0	8	4				
Rent	8	14	2				
Overhead charges	3	5	0				
Cartage	7	14	0				
Railage and f.o.b. charges	7	7	6				
Balance	23	14	4				
	£107	7	1		£107	7	1

CONCLUSION.

Every manufacturer has some system of costing the production of the articles with which he deals. The farmer knows little of what his produce is costing him, and under these circumstances is not in a position to say at what price per bushel or per ton he can produce the crops he grows from year to year. The writer, however, could not recommend a farmer to enter lightly upon a system of costing his crops as adopted on the Moa Farm. In England and some other countries farmers are being induced to keep records of labour and prices, &c., the actual book-keeping being performed at a central station and the returns forwarded to the individual farmers. It is possible that some such movement may be inaugurated in New Zealand.

Cost of Production of certain Farm Crops, Moa Seed Farm, 1921–1922.

(These figures represent the cost on the farm, and no charges have been made for marketing the produce.)

Number of Paddock.	Crop.	Area in Acres.	Total Yield.	Yield per Acre.	Cost of Preparation of Land and Sowing per Acre.	Cost of Seed per Acre.	Cost of Manure per Acre.	Cost of Harvesting per Acre.	Cost of Threshing or Chaffcutting and Depreciation on Sacks per Acre.	Rent per Acre.	Overhead Charges per Acre.	Cost per Bushel or per Ton on the Farm.
					£ s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	
1	College Hunters wheat ..	10	360 bus.	36 bus.	1 12 9	1 7 7	10 6	1 1 4	1 0 10	0 17 5	6 6	3s. 9d. bus.
2	Garton oats	8	490 ,,	61 ,,	1 18 1	0 8 11	10 9	1 3 3	1 1 5	1 4 1	6 6	2s. 2d. ,,
3	Black skinless barley ..	25	1,004 ,,	40 ,,	1 17 5	0 8 2	9 11	1 1 11	1 0 4	1 3 3	6 6	3s. 2d. ,,
5	Alderman peas ..	8	190 ,,	23¾ ,,	2 0 4§	1 9 8	14 4	1 3 6	1 7 11	1 3 2	6 6	6s. 11½d. ,,
6	Velvet wheat	7	303 ,,	43½ ,,	1 17 2	1 0 5	Nil	1 11 2	2 1 7	0 17 8	6 6	3s. 6½d. ,,
7	Italian rye and cow-grass	16	525 ,,	33 ,, *	1 15 1	1 4 5	Nil	0 19 11	0 19 6	0 18 9	6 6	†3s. 9d. ,,
9A	Hero oats (for chaff) ..	7	22 tons	63 cwt.	1 2 0	0 6 3	Nil	1 10 2	2 11 8	1 1 0	6 6	‡£2 3s. 8d. ton.
11A	White Ivory peas ..	8	203 bus.	25½ bus.	1 6 7	0 16 8	9 7	1 17 5	1 0 5	0 18 6	6 6	5s. 3d. bus.
13	Dun oats	12	12 tons	1 ton	1 5 4	0 3 8	9 7	0 9 10	0 16 11	0 14 8	6 6	‡£4 6s. 6d. ton.
13	Rye-corn	12	290 bus.	24 bus.	1 5 7	0 11 7	Nil	0 13 9	0 11 9	0 14 8	6 6	3s. 6d. bus.
13	Cape barley	12	280 ,,	23⅓ ,,	1 5 4	0 15 0	Nil	0 10 2	0 12 2	0 14 8	6 6	3s. 6d. ,,
16	Hero oats	13	955 ,,	73½ ,,	1 18 0§	0 4 1	10 6	1 4 9	1 4 6	1 1 6	6 6	1s. 9d. ,,
16	Hero oats (for chaff) ..	7	21 tons	3 tons	1 18 0§	0 4 1	10 6	1 4 9	2 10 8	1 1 6	6 6	‡£2 12s. ton.
16	William Hurst peas ..	7	273 bus.	39 bus.	2 1 5§	1 17 3	15 1	2 7 1	3 13 1	1 1 6	6 6	6s. 2d. bus.
16	Golden vetches ..	8	188 ,,	23½ ,,	1 19 8§	1 4 7	9 7	3 1 7	3 3 8	1 1 6	6 6	‖8s. 9d. ,,

* Fully 20 bushels per acre of seed lost owing to weather conditions at harvest.

§ Double ploughing.

† Makes no allowance for cow-grass, which will return seed for some years.

‖ From the cost of production is deducted the value of the rye-corn threshed out with the vetches.

‡ Sacks extra.

These returns are published with a full knowledge of the many loopholes they afford for criticism. On the other hand, systematic returns of this kind are rarely kept in New Zealand, and it is certainly work for which there is a wide sphere of usefulness in every agricultural country. Costing accounts as here described have now been discontinued on the Moa Farm, but sufficient returns have been obtained to enable a very close approximation of the cost of production to be made by keeping a record of expenditure and receipts and a diary of horse and manual labour.

FIG. 3. HARVESTING HERO OATS IN PADDOCK NO. 9 AT THE MOA FARM.

This was the most economically produced crop on the farm during the season, although the heavy straw and steep land rendered the cost of cutting with the binder higher than that of any other crop.

Milling Tests of Wheat.—Investigation of the flour-producing qualities of wheat by grinding samples in the model mill at the Department's Chemical Laboratory is being proceeded with. The samples received for testing last season were mainly new varieties from the experimental plots at the Ashburton Experimental Farm and the Marton Experimental Area. This year it is hoped to obtain samples of all standard varieties, grown under varying conditions of locality, climate, &c. It is especially desirable, states the Chemist, that samples of wheat grown in New Zealand districts whose climate approaches that of the best wheat-growing districts in Australia should be tested, in order to ascertain whether wheats approaching in quality those of Australia can be grown here.

Fermentation of Honey in Store.—An investigation by the Biology Section of the Department is in progress with a view to bettering the conditions under which New Zealand honey is stored prior to export. A yeast has been isolated from honey, and its power to ferment under various circumstances is under test. With regard to the exposure of honey to the air for the purpose of increasing its specific gravity, experiments showed that honey acquired more moisture from a damp atmosphere than it could dispose of in the same time under absolutely dry conditions. Specific gravity, ash constituents, and temperature in relation to fermentation, reaction and temperature in relation to granulation, heating as affecting colour, and other matters are being studied.

RECENT LUCERNE EXPERIENCE AT WERAROA.

THE FACTORS OF CLIMATE AND SOIL.

W. J. McCULLOCH, Manager, Central Development Farm, Weraroa.

For a number of years past much has been written and said regarding that wonderful fodder-plant lucerne, but this has been more especially with reference to the proper methods of cultivation and the feeding-value of the crop rather than to its particular adaptability to certain climatic conditions and soils. That lucerne is a most productive and valuable fodder in many localities is, of course, a fact which now hardly needs stating, but to obtain reasonably good results from it suitable natural conditions should exist. For the successful production of lucerne as an economic farm-crop more importance should be given to these two great factors, climate and soil. The variety of our ordinary farm-crops as between different localities demonstrates the great variation of both soil and climate in this country, and although improvement may be carried out by drainage, liming, cultivation, and manuring in order to alleviate certain defects, there are always likely to be instances where a certain limit must not be exceeded, this being sharply defined by the cost of production of the equivalent amount of nutritive value from a more easily produced crop.

Generally speaking, it will be found that the localities where lucerne has been very successful have never been noted for a luxuriant or continuous growth of grass-pasture. Hence one immediately realizes how very valuable lucerne becomes in such cases, and also how much less competition it has to withstand, this latter factor implying a lessened amount of cultivation and consequently greater profit. Possibly ideal lucerne conditions do not permit or warrant the choice of a substitute, but it is the writer's opinion that the farmer who possesses equally good clover and grass-pasture conditions should not envy or endeavour to emulate the successful lucerne-grower. Both are equally fortunate, and should be content so long as each produces in abundance that which is best adapted to his respective district, for it appears impracticable to produce the best of both crops under similar local conditions of climate and soil.

The experience at the Central Development Farm during the last three seasons all goes to demonstrate that with the type of land and climatic conditions obtaining here lucerne-culture is not an economical proposition as compared with clover or grass production. The land in question (which is practically flat) was originally under heavy native forest, and the soil is a good clay loam over a free clay subsoil. The climate of the district is comparatively equable, with a well-distributed rainfall averaging about 40 in. yearly.

In the spring of 1919 field No. 13 on the farm was subdivided into two blocks. One half, which had been previously thoroughly prepared, limed with 2 tons of crushed limestone per acre, and dressed with inoculated soil, was sown broadcast with Marlborough lucerne at 20 lb. per acre. The other half of the field was sown down with a mixture of permanent grasses and clovers. The lucerne

germinated splendidly, and in its early growth gave every promise of becoming a successful stand, being very free of competition from weeds or grasses. It was noticed, however, as the autumn approached and the growth slowed down in preparation for the winter rest of the plant—a most critical period in the life of young lucerne—that certain grasses began to establish themselves in places.

During the first summer two light cuts, totalling about 2½ tons of hay, were produced, and the aftermath given a few days careful grazing by milking-cows. The stand was then closed for the remainder of the season. In March, 1920, the stand, which had now become well rooted, was given three strokes of the spring-tooth cultivator and tine-harrowed, which uprooted most of the grass-plants, &c., leaving the lucerne in an apparently clean condition for the winter. This work was immediately followed by a top-dressing of two portions with 4 cwt. of basic phosphate and 2 cwt. of superphosphate per acre respectively. One block was left unmanured as a control.

During the winter months, and until sufficient heat was experienced in the following spring (1920) to bring the lucerne into full growth, grasses and clovers again made their appearance in all three plots to an extent as to make the contest for future supremacy interesting. Of course, as generally happens in such cases, the first cut in the spring gave a set-back to the unwelcome weed competitors, and the succeeding cuts were much cleaner. The lucerne asserts itself until the beginning of the next rest-period in autumn, when the cycle of events is again repeated, until sooner or later the vegetation best suited to the local conditions is finally in control, whether it be lucerne, grasses and clovers, or weeds.

In the summer of 1920–21 no appreciable difference was noticeable between either of the top-dressed blocks or the control. Two cuts each of about 1½ tons per acre of hay were secured, with a third one later of about 1 ton per acre, followed by a light grazing of the aftermath with stock for a fortnight.

In the early spring of 1921 the whole stand had an appearance similar to that of many others one has seen ploughed under at this period of their existence as failures. It was decided to further experiment with a view of discovering whether such a stand with an abundance of lucerne-plants in it could be renovated, and, if so, whether such practice would be economically sound. Accordingly the area was set out into six plots and treated as follows :—

Plot 1 : Cultivated with the spring-tooth cultivator—five strokes —and tine-harrowed twice.

Plot 2 : Seven strokes with the tine harrows.

Plot 3 : Four strokes with the disks, and tine-harrowed twice.

Plot 4 : Skim-ploughed, and two strokes with the chain harrows.

Plot 5 : Control.

Plot 6 : Drain-ploughed every 30 in., 18 in. deep, two strokes of the spring-tooth cultivator and tine-harrowed twice. (The mole of the drain-plough was canted so as to create a movement of the soil to that depth, and was not used for drainage purposes, this not being necessary.)

The immediate first growth of the plots after this treatment showed distinct variations. Plots 1 and 6 appeared to take the lead for a time, and next in order of merit were plots 3 and 4. The control

plot continued to maintain about the average of the others. As the time approached when it was necessary to make the first cut very little difference, if any, was noticeable between any of the plots, including the control, with the exception of plot 4. This plot had never properly recovered, having a worse bottom with grasses, &c., than previously, and as the majority of the tap-roots had been severed by the plough the effect on the lucerne-plants was very noticeable during a spell of dry weather about the following January and February. On the whole, the results of the different cultivations were disappointing, inasmuch as the control plot gave yields quite equal to the best of the others.

During the growing-period last season numbers of visiting farmers inspected the field, and all expressed themselves as convinced that the amount of attention necessary on this land to control the naturally good grass and clover conditions would make the production of lucerne economically unsound.

In order to further define the position a comparison may now be made with the other half of field No. 13, which was sown in the spring of 1919 in a mixture of permanent grasses and clovers. This portion has been grazed almost continuously the year through with dairy cows, the exception being the month of November and the first half of December in 1920, when it was shut up for hay and yielded 2½ tons per acre, the greater part of which was cow-grass. This, together with the steady and abundant grazing it has afforded all along and still continues to give, is apparently a much superior result to that obtained from the lucerne area, which has given at best a total annual hay crop of 4 tons per acre, with only a very short period of grazing, being shut up during the remainder of the year.

As showing the great adaptability of the land at this farm for clover it may be mentioned that at no time during the last three seasons have any of the fields been shut up for more than five weeks, when not less than from 2 to 2½ tons per acre of first-quality clover hay was produced. It will thus be seen that under similar conditions it must be a more payable proposition to produce that which is better suited to the natural conditions than to struggle on in a costly endeavour to establish something which is not naturally adapted to a locality.

It is quite agreed that lucerne could be successfully grown under the conditions obtaining at this farm if sown in rows and given plenty of intercultivation. As a matter of fact, it has been grown in small plots for a number of years in the farm nursery with careful attention and plenty of hand-hoeing. The amount of work necessary, however, is not justified in field practice, when cow-grass, which is only slightly inferior in feeding-value to lucerne, can be produced much more economically.

NOTE.—The aspect of lucerne-growing dealt with in this article will be further treated in a future issue of the *Journal*.—EDITOR.

Vine-culture under Glass.—There are approximately 880 glasshouses in the Dominion at the present time. The latest estimate of the production of grapes is 552,000 lb., which at last season's wholesale price of 1s. 3d. per pound shows a value of £34,500.

COCKSFOOT-SEED.

NELSON R. FOY, Biological Laboratory, Wellington.

NEARLY all the cocksfoot (*Dactylis glomerata*) seed used in New Zealand is produced locally. A few years ago quantities of Danish seed were imported, but this trade has now fallen off to a few tons annually. It is held that the quality of Danish seed is superior to that of New-Zealand-grown, particularly in regard to germination. In 1920, when a considerable amount of seed was imported, Danish cocksfoot averaged well over 75 per cent., while local Akaroa seed averaged about 55 per cent. The superior quality of the Danish seed may be attributed to the methods employed in Denmark for the growing of the seed. The plants are grown in rows and intercultivated, as against our ordinary method of shutting up a paddock, cutting the crop, and allowing the pasture to more or less take care of itself until the next season. There is no doubt that the row system is responsible for splendid quality seed and a high production.*

The great bulk of the New Zealand cocksfoot-seed is harvested in the Canterbury Province, especially on the hilly Banks Peninsula. The whole of the seed from Canterbury was at one time sold under the general name of "Akaroa cocksfoot," but of recent years that grown on the plains has been marketed separately as "Plains" and that from Banks Peninsula as "Akaroa." In germination Plains seed is equal if not superior to Akaroa, and it would appear as if Akaroa farmers will have to adopt certain methods of soil-improvement, notably along the line of phosphatic top-dressing, if they wish to retain their position as the premier cocksfoot-seed growers of New Zealand. The use of harvesting machinery on the Plains as against expensive hand-labour on the Peninsula, together with the Akaroa farmers' practice of taking off seed crops year after year without returning to the soil the elements of soil fertility removed, are other factors with a similar bearing. The use of power threshing-machines instead of the hand-flail has in both areas lowered the cost of production.

In addition to that cropped in the South Island small quantities of cocksfoot-seed are gathered in the North Island. It is worthy of note that several lines from the King-country tested at this Laboratory have given an average germination of 90 per cent. The cocksfoot growing along roadsides, &c., produces good seed, and when prices are high quantities of this are gathered. At one time Taranaki produced large quantities of cocksfoot, but there, as on Banks Peninsula, the yields and quality dropped on those areas which were cropped successively for many years.

In 1920–21 the total area in New Zealand cropped for cocksfoot-seed was 17,527 acres, which produced 2,724,816 lb. of seed, or an average of 155·46 lb. per acre. The estimated figures for 1921–22 are 15,613 acres and 2,823,142 lb., or 180·82 lb. per acre. Canterbury's share of the total area in 1920–21 was 16,416 acres.

* See the account of a trial of the Danish system at Ashburton Experimental Farm, published in last month's *Journal*, page 18.

Germination.—In comparison with most of the English grasses cocksfoot is a low-germinating seed, and may be graded as follows: 80 per cent. or over, first-class commercial line; 60 per cent. to 79 per cent., good average line; 40 per cent. to 59 per cent., below average quality; 39 per cent. or under, little value.

The following table shows the average germination of all the cocksfoot-seed germinated at this Laboratory during the last six years ending 31st March:—

Year.	Number of Samples tested.	Average Germination.	Year.	Number of Samples tested.	Average Germination.
		Per Cent.			Per Cent.
1916–17 ..	252	66	1919–20 ..	448	57
1917–18 ..	219	57	1920–21 ..	462	55
1918–19 ..	288	56	1921–22 ..	548	64

It will be noticed that the average germination for 1921–22 is well above that for the previous four years. It is very probable that heavier machine-dressing is responsible, as in the previous year prices were much higher and less attention was paid to turning out a high-grade seed.

Mention may again be made here of the two methods in use of obtaining the germination capacity of grass-seeds—one being the Continental (European) method and the other the Irish method, the latter of which is employed in this Laboratory. The essential difference between these is that in the Continental method only those seeds which are fully matured are tested for germination, the immature ones being picked out and counted as impurities, while in the Irish method the immature and empty seeds are included in the germination tests. In cocksfoot the kernel or true seed is surrounded by a covering known as a glume or husk, and it is the inclusion of these empty glumes in our New Zealand tests which causes our germination percentages to be so much lower than those from Denmark or Switzerland. On the other hand, our purity is much higher, as only extraneous seeds and not the empty glumes are counted as impurities. An actual instance may be given on a sample of cocksfoot-seed which was tested here and then forwarded to the seed-control station of Zurich, Switzerland, one of the principal seed-testing stations of the world. The results were—Zurich, 89 per cent. germination, 85·4 per cent. purity; New Zealand, 70 per cent. germination, 93·0 per cent. purity.

Of course, the heavier the machine-dressing the greater is the quantity of empty glumes removed, and a consequent higher germination and bushel weight results. During the year 1920–21 the average percentage of empty glumes on all the samples tested here was 20 per cent., and for the year 1921–22 18·5 per cent. If the seed had been free of empty glumes the germination would have averaged 70 per cent. instead of 55 per cent. Danish seed rarely contains much more than 10 per cent. of empty glumes.

Bushel Weight.—The commercial standard bushel weight for cocksfoot in New Zealand is 16–17 lb.—that is, good average, while 20–21 lb. lines may be considered first-class. Nothing less than 13–14 lb. should be entertained. The number of seeds per pound of cocksfoot varies considerably. In general the higher the bushel weight the smaller the

number of seeds per pound; 16–17 lb. seed averages about 620,000 seeds per pound, while lines of 20 lb. seed will contain not more than 520,000 seeds per pound. The higher the bushel weight the higher the germination, as is instanced by a line dressed to two weights—standard (16–17 lb.) and fully dressed (21 lb.)—and then germinated. The former showed a germination of 61 per cent. and the latter 90 per cent. The cost of producing the higher quality was, of course, greater—approximately 10 per cent.—but it will be seen that the latter proportion is by far the better value—another 90,000 plants per pound of seed for an extra 1d. or 2d. per pound.

GROWTH OF 1922 SEASON COCKSFOOT AFTER TEN DAYS IN THE GERMINATORS.

Left—20-lb. seed: 92 per cent. germination. Note strong growth of leaf and root-system.

Right—13-lb. seed: 45 per cent. germination. Note presence of non-germinating empty seeds.

[*Photo by E. Bruce Levy.*

Purity.—During the year 1921–22 ninety samples of cocksfoot-seed were tested for purity at this Laboratory, and gave an average of 2·5 per cent. of extraneous seeds. Thirty-seven different species of extraneous seeds were noted. The names and relative frequency of occurrence of the main species are as follows: Perennial rye-grass in 81 samples, Yorkshire fog 68, goose-grass 62, catsear 53, rib-grass 22, Poa pratensis 20, curled dock 16, hair-grass 12, crested dogstail 10, sorrel 9, sweet vernal 7, hawkweed 6. The seeds of noxious weeds are practically absent from cocksfoot-seed.

Indications of origin: The combined presence of Yorkshire fog, goose-grass, and catsear is usually indicative of New Zealand seed. A fairly high percentage of perennial rye-grass may be regarded as indicative of Plains seed, while vetches are not uncommon in Akaroa seed.

Adulteration: Cocksfoot-seed is rarely adulterated, excepting perhaps by the inclusion of rye-grass to bring up bushel weight or to change the indication of origin.

RECLAMATION OF SWAMP LAND.

OPERATIONS AT WI TAKO PRISON FARM, TRENTHAM.

J. M. SMITH, H.D.A., Assistant Instructor in Agriculture, Wellington.

In view of the large areas of unreclaimed swamp land existing in various parts of New Zealand it may be interesting to recount the experience gained at the recently established Wi Tako Prison Farm, Trentham, where during the last twelve months a large area of wet, sour, unproductive swamp has been converted into fertile agricultural land. The swamp in question should be well known to many of our soldier farmers who were trained at the Trentham Camp, as many a military manœuvre during their training took them over the area which is now part of the Wi Tako Farm. The swamp, which is situated just to the right of the Trentham Rifle Range, and immediately over the spur which runs down in front of the Heretaunga Railway-station, is approximately 100 acres in area, and is similar to many other swamp areas in the Wellington Province, notably those in the vicinity of Paraparaumu, which lie between the railway-line and the sea, but is inferior to the alluvial swamp at Makerua.

Originally the swamp appears to have carried heavy forest, consisting chiefly of white-pine, as is evidenced by the large logs and roots which have to be dealt with during draining operations, and which in themselves constitute one of the problems of breaking in swamp lands. The forest was probably removed for milling purposes, and the scrub and undergrowth burnt off and a surface sowing of some grass-mixture made on the ashes; but, generally speaking, this grass has been smothered by flax, manuka, rushes, blackberry, and other growth common to swamp land. In places, however, the grass has persisted, cocksfoot being very much in evidence and doing well on the drier portions, a fact in itself an indication that if the surface water were drained off, and the undergrowth and roughage burnt, a surface sowing of some good permanent-grass mixture should have the desired effect of turning the swamp into productive land without going to the expense of removing the timber and breaking up the land with the plough. This latter method, however, is the better and more thorough method of bringing the swamp in, and is the mode of procedure which will have to be adopted sooner or later.

When the area was first taken over by the Prisons Department the water-table was extremely high, and it was an almost impossible task to get across the swamp dryshod, stock being able to graze on its scanty pasture only during the drier periods of the year. The first difficulty to be overcome in this case, as with all swamp land, was to get rid of the surface water. It is a well-known fact that well-drained land is better supplied with water in the summer and drier in the winter than land which is badly drained. Strange to say, in spite of this fact, many farmers have been known to leave their swamp lands in a natural state, believing that by so doing they will have more moisture there in the summer and autumn when their other paddocks will have dried out. This is quite a wrong supposition, as has been proved over and over again.

GROWTH OF PHORMIUM AND RUSHES ON THE SWAMP AREA AT WI TAKO BEFORE RECLAMATION.

PART OF THE RECLAIMED AREA, WITH LATERAL DRAIN IN CENTRE.

Crop of turnips on left, and fallow-ploughed ground on right.

In draining, trouble is often experienced in getting the necessary fall, this being the case with many of the Paraparaumu swamps, where the swamps have been formed in basins with no natural outlet. At Wi Tako, however, this difficulty did not occur, as there is a good natural fall towards the Hutt River, so that the draining was straight-out work. At some previous date an attempt had been made to drain this swamp, but the drains proved incapable of carrying off the large amount of water which was continually seeping out of the hills and the storm-water present after exceptionally heavy rain. These drains were deepened to the depth of 6 ft., and used as main drains leading from all low-lying parts of the swamp, while lateral ditches were dug and arranged so that the swamp was systematically drained. In no way did the drainage interfere with the ploughing and general cultivation of the paddock.

After having got rid of the swamp water, the next question was how to deal with the scrub and undergrowth. When the area was fairly dry men were put on to cut and burn the manuka, &c., which was cut off at the ground and allowed to dry before being burnt. Then came the biggest problem of all—what to do with the timber lying just below the surface. Fortunately, plenty of labour was available, the farm being worked by prisoners, so they were set to work with the spade and crow-bar, and the wood was removed by manual labour. Of course, to bring in a large area by this means would be far too expensive for the ordinary farmer, but two alternatives would be at his disposal. He could burn the timber out, which would be an unsatisfactory method, as it would be by no means thorough; or he could reclaim an acre or two each year, and so gradually bring his whole area to a state of productivity. In the latter case it would be advisable to burn off the scrub and sow some grass-mixture, so that the area would be of some use while it was being slowly brought into cultivation.

Having removed the timber, the next step was to set to work with the plough and get the ground turned over and broken up. It is worthy of note that the only implements then available for this work were a small single-furrow plough, a set of disk harrows, and two leaves of tine harrows; so that it can in no way be said that the means the management had at its disposal to cultivate the rough swamp land were beyond the reach of the ordinary farmer. It would have been an advantage to have used a roller had one been available, as the light peat does not make a good firm seed-bed unless it is consolidated, and it dries out too easily in the dry weather. This year a swamp-plough has been obtained, which will facilitate matters greatly and do away with a great deal of the manual labour that was necessary to remove the smaller roots of the manuka and flax in order to enable the small single-furrow plough to do its work with even any degree of efficiency.

During cultivation the land was limed with Mauriceville crushed limestone at the rate of 1½ tons per acre, peat-swamp soils almost invariably having an acid reaction.

As there was practically no pasture of any consequence on any part of the farm, the area other than the swamp being made up of poor hill country, it was decided to put some of the area down in temporary pasture. With this end in view the highest and driest portions of the swamp were fenced off and cultivated. The seed-bed was not all that could be desired, on account of the lack of necessary implements to

carry out thorough cultivation, and when this fact and the fine result achieved are taken into consideration it will be realized that the swamp is composed of excellent soil. On one area a mixture of 30 lb. of Italian rye-grass and 6 lb. of cow-grass per acre was sown in September last. This came away extremely well, was grazed almost continuously during

SAMPLE OF THE SOFT-TURNIP CROP (HARDY GREEN GLOBE VARIETY).

PIGS GRAZING IN THE RYE-GRASS AND COW-GRASS PADDOCK.

the summer months, and is at the present time showing a great growth of clover. On another area the mixture used was 30 lb. of perennial rye-grass and 6 lb. of cow-grass per acre; while on a third 2½ bushels of oats and 6 lb. of cow-grass per acre were used. The sowings were made fairly heavy on account of the sour, clayey nature of the soil.

These last two areas mentioned have been grazed with pigs ever since they were established, and are looking well at present, the sole of grass being good and the growth strong and vigorous.

The larger portion of the newly broken swamp was sown with roots, but owing to the extremely wet spring experienced the sowings of these, especially the mangolds, were delayed considerably. The drainage-system was given a good trial during the wet weather, and it was noticed that practically all the surplus water got away quickly, and the land soon dried when the rain ceased. On one part of the area Hardy Green Globe turnips were sown at the rate of 12 oz. per acre in 21 in. drills, with 2 cwt. of Ephos phosphate per acre, and the result was highly gratifying, the crop yielding approximately 50 to 60 tons per acre of good sound roots. On another portion two varieties of mangolds were sown, Long Red and Yellow Globe. As already stated, these were sown a little too late (November), and the wet season which followed the sowing was against them. Notwithstanding this, and the fact that only 4 lb. of seed per acre was sown, the yield was fairly satisfactory. Good crops of carrots and parsnips for use at the prison were also grown; and taking the season, conditions, &c., into consideration it may be said that the crops generally were very satisfactory.

There is still a large area of the swamp in the rough state, but it is the intention of the management gradually to bring this under cultivation as time and opportunity permits, and it will be only a matter of time before the whole swamp will be producing fodder, in the form of roots and hay, with the best of the land in the district. It may be stated that by arrangement with the Prisons Department the Wellington agricultural-instruction officers of the Department of Agriculture are supervising the farm operations at Wi Tako.

ASHBURTON EXPERIMENTAL FARM.

NOTES ON SUNDRY OPERATIONS, SEASON 1921–22.

F. E. WARD, Instructor in Agriculture, Christchurch.

A COMPREHENSIVE account of the work being carried on by the Department at the Ashburton Experimental Farm, Canterbury, was published in the *Journal* for September last year. Since then some special notes on the lucerne-culture experiments and cocksfoot-seed production test have appeared (December, 1921, and April and July, 1922, issues). A brief account of the progress of other operations during the season 1921–22 is now given. As previously, the work was in the capable hands of Mr. J. G. McKay, Farm Overseer, from whose records the following notes have been compiled.

PASTURES.

Pasture Establishment with and without Rape.—In order to test the advisability of sowing down a pasture with rape, 5 acres was sown with rape in November, 1920, together with a seeding of 24 lb. of perennial rye-grass and 6 lb. of red clover per acre. The 5 acres

adjoining was sown down with the same mixture after rape in April, 1921. There is a much better sole of grass on the latter plot. The two fields were thrown together during last summer, and a good deal of reseeding has taken place on the first plot owing to the preference of the stock for the young grass on the autumn-sown crop. The clover is better on the first plot, but the rye-grass is superior on the autumn-sown portion. Under Canterbury conditions the practice of sowing grass after early rape is to be recommended in preference to sowing grass with rape, the only exception being on first-class pasture land, where greater liberties can be taken. Under such conditions the grasses quickly establish, and are not so likely to be injured by stock in feeding off the rape.

Tall Oat-grass.—An area of 4·75 acres was sown down in April, 1919, with 40 lb. per acre of tall oat-grass in an attempt to establish a permanent pasture. Though it promised well the first year, and self-sowing took place to some extent, the tall oat-grass is now running out, and the pasture is composed largely of yarrow and suckling-clover. It is intended to plough up the area this spring.

Top-dressing.—A top-dressing experiment has been carried out on an old pasture, the field being divided into five plots and the following applications per acre made: (1) 10 cwt. slaked lime, applied on 19th August, 1921, and 2 cwt. superphosphate, applied on 2nd September, 1921; (2) control plot; (3) 2 cwt. superphosphate, applied on 7th September, 1921; (4) 4 cwt. Nauru ground phosphate, applied on 7th September, 1921; (5) 1 cwt. dried blood and 1 cwt. superphosphate, applied on 7th September, 1921. Up till the autumn of this year there was no difference in the amount of feed on the different plots, though the season was favourable, but the sheep showed a decided preference for plot 1. During the winter, however, the area has been grazed with dairy cows, and in August the quantity of roughage on the control plot was in marked contrast to that on the manured areas. The former showed much evidence of hair-grass and mossy conditions, whereas the lime and super plot showed a clean sole. The applications specified are being repeated this season.

ROOT AND FODDER CROPS.

In this section twelve different crops were tried, comprising green and purple kohlrabi, Purple-top Mammoth, Lincoln Red Globe, and Red Paragon turnips, Partridge peas, chou moellier, Thousand-headed kale, Buda kale, Essex rape, Japanese millet, and Sudan grass. Kohlrabi gave a comparatively low yield and could not be regarded as a substitute for turnips. Of the fodder crops chou moellier gave the greatest yield, but Thousand-headed kale gives a second grazing and for this reason is preferable. Neither are such rapid fatteners as rape, but they keep probably a month or five weeks longer after coming to maturity; they are also more blight-resistant than rape. None of the other fodders tested showed any outstanding feature.

Maize: The varieties grown were Ninety-day and Hickory King. Contrary to common experience, Hickory King gave a heavier yield and withstood frost the better of the two. Owing to the limited summer rainfall usually experienced in the Ashburton County maize cannot be regarded as a profitable crop even for dairying purposes.

POTATOES.

Cut versus uncut Seed.—A test with the following varieties gave interesting results as detailed (the figures representing tons per acre) :—

Variety.	Uncut Seed.			Cut Seed.		
	Table.	Seed.	Pig.	Table.	Seed.	Pig.
Dakota	4·40	0·80	0·30	3·01	1·25	0·30
Manhattan	2·90	2·20	1·03	1·75	1·90	0·62
Gold Coin	1·38	1·47	0·50	1·38	1·00	0·50
Arran Chief	Nil	2·90	1·25	0·25	2·13	1·10
Up-to-Date	1·13	1·25	0·80	0·62	1·13	0·70
British Queen	0·50	3·08	1·01	0·26	2·96	0·98
New Era	0·91	4·56	2·06	0·65	4·13	2·01
Bresee's Prolific ..	1·95	3·94	1·35	0·72	2·47	1·22
Snowdrop	0·25	3·55	2·08	0·39	3·26	1·63
Reading Russet ..	1·75	3·96	0·98	2·70	1·98	0·39
Snowflake	3·34	1·63	0·40	3·39	1·25	0·12
Average ..	1·68	2·66	1·07	1·37	2·13	0·87

In the previous season the tubers had been cut and left for several days before sowing, and very uneven germination resulted. This past year the cut tubers were dusted with burnt lime prior to sowing, to prevent bleeding, and the results were more satisfactory, very few misses occurring. It would appear from this experiment that uncut seed produces the greater quantity of marketable potatoes, also more pig potatoes, the yield generally being heavier.

Size and End of Seed.—An experiment was carried out with Arran Chief potatoes to determine which end of the potato makes the better seed, also regarding the size of seed and its relationship to yield. The results, in tons per acre, were as follows :—

	Table.	Seed.	Pig.
Stem end planted only	0·60	2·00	1·00
Rose end planted only	1·44	2·25	1·88
Large seed*	1·27	4·00	2·06
Medium seed*	2·09	3·42	1·50
Small seed*	1·50	3·48	1·20

* Whole tubers.

Powdery Scab.—An area had been planted with badly infested powdery scab seed the previous season, and a clean crop of potatoes lifted. To ascertain if the disease would be carried over in the soil a sowing of clean Dakota seed was made last spring on the same area, and another perfectly clean crop was lifted. These results are interesting in view of the embargo placed on the importation of New Zealand potatoes into Australia.

Destruction of the Kea.—During the last financial year 6,315 kea-beaks were brought forward as evidence for claiming the subsidy of 5s. per beak granted by the Government to encourage the destruction of this bird.

THE CARE AND GRADING OF CREAM.

W. DEMPSTER, Dairy Instructor, Hamilton.

THE methods of handling cream at the dairy factories in New Zealand compare more than favourably with those of other dairying countries, but our weakness lies in the handling of milk and cream on the farm. It may be said that there are only about 10 per cent. of the dairy-farmers really doing their best, while at the other extreme of the scale are another 10 per cent. who should really not be milking cows at all. The cream-graders' greatest trouble is with the 80 per cent. of farmers who deliver only a medium cream.

It is sometimes very difficult for a grader to convince a supplier that his cream is second grade, as perhaps he is doing all he can, and very often going to more trouble than is necessary to ensure first-grade. If, however, the lay-out of his shed is bad it may be difficult to get first-grade. Cream when leaving the separator is just about at the best temperature to take a taint, and if the atmosphere be impure the cream is certain to pick up whatever smell there is. The cream will smell just as does the separator-room or place where cream is kept. It does very little good to shift cream after separating in an impure atmosphere, but it is not so bad as leaving the cream there. One frequently hears complaints from farmers because their cream was graded second when not sour, sour cream being in their opinion the worst of all. It is natural for cream to go sour; when cream will not go sour it is a sure sign of inferiority. I have known farmers to prefer rancid to sour cream. It is difficult to get two cans of cream exactly alike in flavour. So well versed do most graders become that they can remember the flavours of each individual farmer's cream as easily as they remember the cans. The flavour is just as distinctly impressed on the grader's mind as if he had seen it.

The following points are essential in practice if the farmer is to continue the good work which the cow begins. If he is neglecting any of these essentials he cannot be said to be doing his best, and has no cause for complaint if his cream is graded other than superfine.

(1.) Every part of the milking-machine, vacuum pipes and tank, separator, &c., must be kept clean.

(2.) The releaser-bucket and separator must not be in the engine-room. A passage between the separator-room and the engine-room is necessary.

(3.) Milk should be separated and the cream kept in a well-ventilated room, and the cream stirred often with a metal plunger.

(4.) The cream should be cooled with a water-cooler. Putting the cream in a tub of water is not sufficient.

(5.) The environment of the separator-room and place where the cream is kept should not be muddy.

(6.) A plentiful supply of boiling water is necessary. ("Hot" should not be mistaken for "boiling.")

If these six essentials are observed, second-grade cream will be only an accident. There are many backblocks settlers carrying out these essentials with good results, while other farmers in the backblocks

are complaining about their inability to produce a first-quality cream, giving as reasons the difficulties which have been overcome by others.

The following are a few causes of second-grade cream. All but the last cause contamination flavours, and are in the hands of the farmers to remedy.

(1) Badly arranged shed; (2) neglecting to cool cream; (3) mixing warm and cold cream together; (4) having the engine and separator in the same room; (5) failure to clean the vacuum-pipes and vacuum-tank, and to leave the vacuum-tank open; (6) dirty rubbers and milk-pipes; (7) putting rubbers in stagnant water; (8) lack of ventilation in separator-room; (9) muddy surroundings near separator-room; (10) not removing lids after washing cans; (11) use of rusty cans and tinware; (12) using separator-room as storeroom; (13) use of carbolic disinfectants; (14) skimming too thin; (15) neglecting to scald tinware; (16) sour skim-milk barrels; (17) washing the separator only once daily; (18) keeping cream too long on farm; (19) standing cans in the sun awaiting conveyance; (20) using cloths for straining, and also for washing instead of a brush; (21) feed-flavours.

The following are a few flavours in cream which are easily recognized, together with their causes:—

(1.) Stale: This flavour is caused by keeping cream too long in unsuitable place; neglecting to cool cream; mixing hot and cold cream together; skimming too thin and not stirring. A small quantity of this cream will flavour a whole vat and is always graded second grade.

(2.) Maori bug: This is a smell much like that which a Maori bug emits when disturbed or crushed. A little of this cream will flavour a whole vat. It may be caused by the separator and tinware not being properly washed and scalded, yellowish slime forming on the tinware. Often a cloth more or less impregnated with the same slime is used for the strainer and for scrubbing. The flavour is accentuated by mixing hot and cold cream. Such cream should always be graded second, and in bad cases should be returned.

(3.) Fermented: Such cream is full of gas-holes, sometimes as large as a shilling. It often works like yeast and overflows the cans. Causes may be putting cream into cans which have previously held milk and have not been properly cleansed and scalded; neglect to cool cream; mixing hot and cold cream; keeping cream too long. Such cream is always second grade.

(4.) Tallowy: The cream smells and tastes like tallow. The flavour is caused by washing the bowl of the separator with slimes in it, then washing tinware in same water; putting cream into a warm can or standing the cream in sun; contamination from sheep-skins or harness in dairy; washing the separator only once daily.

(5.) Curdy or cheesy: This is a taste resembling bad cheese. The causes are skimming too thin and not cooling; taking up taints from stores in the dairy, or oil and spilt milk on the separator-stand; bad ventilation; keeping cream too long without stirring.

(6.) Sour: The cream tastes sour to a disagreeable extent, but this may not be due to lactic acid. The causes are skimming too thin and not cooling; keeping the cream too long on the farm in a warm atmosphere; the presence of sour skim-milk barrels in close proximity to where the cream is kept.

(7.) Milking-machine: This flavour is caused through not cleaning rubbers, vacuum-tank, pipes, and releaser, or from perished rubbers.

(8.) Kerosene and benzine: Flavour caused by having the separator or releaser-bucket in the engine-room; kerosene and benzine stored in dairy; smoky kerosene-lamps; exhaust from the engine not carried to leeward; using benzine-tins as buckets; using roof-water for washing utensils.

(9.) Carbolic: Flavour caused by using disinfectants in the shed or on cows' teats.

(10.) Metallic: Flavour caused by cream being put into rusty cans, or rusty tinware coming into contact with milk.

(11.) Ropy: The cream lifts in strings. Caused by unhealthy cow or cows drinking stagnant water.

(12.) Rancid: Caused by chemical changes brought about through lack of cleanliness and high temperature, causing a third-grade cream.

(13.) Buttercup: This flavour is prevalent in early spring. The flavour is bitter, resembling that of radish, and is sharp and pungent to the nose. The cream is generally of a high colour.

(14.) Watercress: This is an acetic-acid flavour, dull and pungent to the nose, and is more troublesome in autumn.

(15.) Pennyroyal: An easily detected flavour, smelling like pennyroyal.

(16.) Turnips and rape: Very objectionable flavours imparted by these feeds.

(17.) Cowy: Due to using milk too soon after the cow has calved. May also be due to bad drainage in the cow-shed or to unhealthy cows.

(18.) Musty: Caused by cream being kept in a wooden building with no ventilation, or by decaying timber in the separator-room.

OCCURRENCE OF APOTHECIA OF BROWN-ROT IN NEW ZEALAND.

For several seasons a search has been made for the apothecia of brown-rot in New Zealand, but without success. This past season, however, the writer has had numerous experiments carried out with a view to obtaining these fructifications. With the kind concurrence of Mr. A. W. Green, Manager of the Ruakura Farm of Instruction, the experiments have been carried out at the farm by Mr. T. Roach, Horticultural Overseer, to whom the writer's thanks are due for his care in the matter. Several thousand mummies of nectarine, peach, and plum were collected and placed at varying depths in the soil. Apothecia began to appear the first week in September, and mature specimens were obtained on the 9th. They appeared in numbers at ground-level, occurring only on those mummies which had been partially buried in the soil. Microscopic examination shows the asci and spores to agree in size and other details with the descriptions of those occurring on stone-fruits in Europe, and confirms the identification of our organism with *Sclerotinia cinerea* Schroet. The appearance of these fructifications indicates that the coming season will be a severe one for brown-rot. It would accordingly be advisable for stone-fruit growers to make certain of their early sprays. Further particulars will appear in next month's *Journal*.

—*G. H. Cunningham, Biological Laboratory, Wellington.*

SEASONAL NOTES.

THE FARM.

FIELD-CROPS AND PASTURES: NORTH ISLAND.

GREEN CROPS for green feed, hay, or ensilage may still be sown. Mixtures of Algerian oats and peas or tares will be found very suitable, 2 bushels of oats to 1 of peas or tares being a good average seeding. Grey Partridge and Early Minto peas are the best for this purpose. Any good phosphatic manure, at the rate of 2 cwt. per acre, is suitable under average conditions, but basic super may be used for preference, or superphosphate if the land has been recently limed. Mixtures of half super and slag, Ephos, or Nauru phosphate are also good.

Early sowings of rape should be made during October where the land is at all warm. Good manures are mixtures of super and Nauru, or super and slag. Freezing-works manure will also be found very useful.

Land for mangolds, carrots, and soft turnips should be well worked in preparation for sowing about the end of October or early in November. In warm situations sowing may be made any time after the middle of October. Soft turnips for cow-feeding are required between January and April (where allowed), and on the average 1 acre to every fifteen cows should be provided. Good varieties are Lincolnshire Red Globe, Red Paragon, and Imperial and Hardy Green Globe. These may all be sown at the one time and the reds fed first, or the greens may be sown two to three weeks after the reds. Manure should be used at the rate of about 3 cwt. per acre. Suitable mixtures are the same as those recommended for rape. Sowing should start about the end of October.

Among the best varieties of mangolds are Prizewinner, Jersey Queen, Half Sugar, and Long Red. These can be sown in drills 26 in. to 30 in. apart, at the rate of 5 lb. to 6 lb. per acre. With average soils manure should be used at the rate of 4 cwt. to 6 cwt. per acre. Suitable mixtures are 3 parts super, 1 part bone-meal, and 1 part Nauru or slag; or mixtures of half super and half Nauru, slag, or bone-meal; or special mangold-manures. In addition to the ordinary manure, salt or kainit should be applied at the rate of 3 cwt. per acre; the salt is best applied by broadcasting just before the seed is sown, or it may be put on after the seed is sown. It is a good plan to provide 1 acre of mangolds for every twenty cows or their equivalent. Mangold-seed is sometimes steeped in soft water for ten to twelve hours, and then allowed to dry for another ten hours before sowing. This gives good results provided the ground is not very dry at the time of sowing; in the latter case the seed germinates with the absorbed water, and there not being sufficient moisture in the soil to carry the plant on it often dies. If uncertain of the weather the best plan is to sow half soaked seed and half dry seed.

Matchless White and Champion are two good varieties of carrots. They should be sown in drills 18 in. to 28 in. apart; seed, 1½ lb. per acre; manure, similar to that for mangolds, 3 cwt. to 4 cwt. per acre. Carrots can be put in about the same time as mangolds, allowing about 1 acre to every thirty cows. Generally both mangolds and carrots should be sown in drills wide enough to allow of horse cultivation, but if only small areas are to be grown and the work done by hand 14 in. to 18 in. drills are best.

The mangold-field is a handy place in which to sow a few drills of potatoes for domestic use. Northern Star, Gamekeeper, and Maori Chief are among the most successful varieties, on account of their resistance to disease.

The sowing of grain crops should now be mostly finished, but oats and barley may still be sown; in fact, October is one of the best months for sowing barley in the wetter situations. The manure should be chiefly superphosphate. October is also a good month for sowing peas and tares. Peas should be sown at the rate of 2½ to 3 bushels per acre, and tares 2 bushels per acre. Good varieties are Grey Partridge and Early Minto peas and grey and golden tares. Cereal crops that have been fed off recently should get one or more strokes of the tine harrows, followed by the roller if the land is dry.

Land intended for later turnips and other forage crops should be well worked up with the disks and cultivators for sowing in November and December.

Fields intended for haying should be shut up about the middle of October, after a chain-harrowing has been given.

SOUTH ISLAND.

The season, up to the time of writing, has been favourable in most districts for sowings of any description, and cereals should be well forward. Sowing of spring oats should be finished during October, and barley may be sown. When the sowing of cereals has been delayed it should be borne in mind that heavier rates of seeding must be given, with a quick-acting fertilizer such as superphosphate. Autumn-sown wheat may be harrowed.

The main rape sowings commence in October. If it is intended to sow down to pasture in the autumn after rape October is quite late enough for this crop. Where required for green feed in January, oats and vetches may be sown towards the end of the month; also such summer forage crops as Thousand-headed kale, chou moellier, or cabbages for dairy cows.

Mangolds and carrots should be sown towards the end of October. If the mangold crop is sown on ridges the horse cultivator can be run through the crop at a much earlier stage than if it is grown on the flat. On heavy land the combined ridger and sower often brings the clods to the top of the ridges, where they form a bad seed-bed. On this class of land it is better to set up ridges with a drill plough, sow half the manure in the bottom of the ridges, split them back over the manure, and sow the seed and the rest of the manure with a combined ridger and sower having the disks removed.

In preparing land for turnips the prevalence and seriousness of club-root should be remembered, and two crops of turnips not taken off the one piece of land in succession. Where the previous season's crops showed signs of this disease it is foolish to sow turnips or any allied crop on that same ground for a considerable length of time.

October sees potato-planting well in hand. Second earlies are put in, and the main crop may be planted towards the end of the month. Second earlies which are likely to be in demand include Snowdrop, British Queen, and Early Rose, while Arran Chief, Northern Star, Up-to-date, Dakota Red, and Dalmeny Hero are popular main-crop varieties. Care must be exercised to see that all seed is in a good sound condition, and where indications of disease are present any infected seed should be discarded. Seed showing signs of scab is best treated by dipping the tubers into a formalin solution made up of 1 pint of formalin to 36 gallons of water.

With favourable weather, temporary pastures of perennial rye-grass and cow-grass—say, 25 lb., and 4 lb.—may be sown. Spring-sown pastures excel autumn-sown in clover content, unless the latter are sown very early—say, in January or February.

Under Canterbury conditions October is quite early enough for sowing lucerne, and the season may extend through to the end of February. October seeding is only practicable where the land is thoroughly clean. This early sowing will probably allow the plants to escape the ravages of the grass-grub.

—*Agricultural Instruction Service.*

THE ORCHARD.

MOST well-managed orchards will now be in a state of good cultivation; others could claim that classification if the land were cleaned up around the base of the trees. In too many orchards, after ploughing and harrowing has been done, large open furrows remain beside the trees, causing the main arms of the roots to be almost if not quite exposed to the surface and subject to the drying influence of the atmosphere, while closer about the base of the trees are mats of couch-grass or other weed, the accumulation of years. This is a serious condition, under which the trees cannot acquire that vigorous healthy state necessary to combat disease and continue to carry good crops. To complete the cultivation of such an orchard is a laborious operation, but very necessary. It is very much easier to make a thorough job of the cultivation from year to year, and much more profitable.

Spraying is the most important work for October. Requirements under this heading vary greatly in different orchards at other seasons of the year, but

at this season fungicide spraying, at any rate, is a universal necessity. Ruined crops are often accounted for by the fact that the applications were not made at the right time because the land was too wet to work on, or the spray-pump broke down, &c. Before giving in to these difficulties the grower must realize that such action means almost a total loss of the crop. There is a glut of such damaged fruit on the market at the present time. The commonest of these difficulties—spray-pump trouble—is overcome to a large extent if the machine is made the responsibility of one person.

During the month apple-trees come into blossom and stone-fruit and pear trees set their fruit—stages of growth at which essential sprays must be applied. Apple-trees, as the flower-buds break, must be sprayed with lime-sulphur or bordeaux for black-spot fungus; the former is the more popular mixture, but the latter is stronger and is used in cases of special difficulty even though it russets the skin of most varieties of apples. The dilution of lime-sulphur (33° Beaume) should be 1–30 to 1–50, according to locality. Those using home-made lime-sulphur require a Beaume hydrometer to ascertain its specific gravity, and a dilution-table to enable them to make a correct dilution: too often a half-strength concentrate of lime-sulphur is diluted as for a full-strength one, and is so rendered inefficient. Where bordeaux is used the formula should be 3–4–40, and the mixture should be tested with litmus paper or by other means to make sure that the acidity of the copper sulphate is fully neutralized by the milk of lime.

When the flower-petals fall from the apple-trees a fungicide must again be applied, and lime-sulphur, 1–100 being the usual strength, or bordeaux, 3–4–40, is recommended. On this occasion cream up 3 lb. of arsenate-of-lead paste, or half that weight of powder, for every 100 gallons of lime-sulphur or bordeaux, and add to the latter after diluting well. As a precautionary measure against spray-burn it is advisable to stir the milk from 3 lb. or 4 lb. of quicklime into the arsenate-of-lead solution before it is added to the 100 gallons of lime-sulphur. Pear-trees at the same stage are sprayed for black-spot with bordeaux, 3–4–40, to which arsenate-of-lead paste is added at the rate of 3 lb. to 100 gallons.

Stone-fruit trees have suffered so much of late years from brown-rot fungus that it is now necessary to apply summer fungus sprays. When the petals fall spray with lime-sulphur, 1–120.

A vigilant watch should be kept for black or green aphis. When first noticed an application of Black Leaf 40 should be made at a dilution of 1–800, to be followed a few days later by another similar application. Very badly affected twigs should be removed and burnt.

A large amount of grafting is being done in commercial orchards; as this is an expensive operation, particularly when unsuccessful, great care and neatness should be taken with the work. The knife used must be of good steel and have a keen edge. Many losses are due to ragged cutting. This work should now be put in hand without delay.

—Orchards Branch of the Horticulture Division.

POULTRY-KEEPING.

THE early part of October should see the last of the hen-eggs placed in the incubators or under broody hens. Chickens brought out later than the first week in November are usually next to useless for profit-making. Now that some of the early-hatched birds are being drafted from the brooder to the colony-house I would again emphasize the importance of placing them in clean quarters and clean runs. In these days of disease and frequent lowering of the vitality and the productive power of birds it is obvious that if sound development is to be attained the growing chickens must be fed and managed to the best advantage from first to last. Poultry-sick soil is obviously not conducive to this end. It is sound economy to put a wire-netting partition down the middle of a run, and so keep the birds off one half in order that the grass or other crop being grown on the other portion may be given a chance to come away. If chickens are to make the best growth the clean run is just as necessary as the clean house. Never forget that chickens will do better on a small piece of clean ground than on a large area of tainted soil. In the case of the latest-hatched stock a special effort should be made to place them on fresh ground. Too often the

late-comers have to follow stock hatched earlier in the season, and are compelled to run on stale and tainted runs. In the circumstances they seldom or never make satisfactory growth.

I have always favoured the alternate run to a poultry-house, and the greater my experience of utility-poultry keeping the more I realize the importance of it. On all plants an endeavour should be made to turn over and sow down a certain number of runs each year, so that the young stock in particular may have frequent changes on to clean and fresh ground. Especially does this apply where the soil is of a heavy clay nature. Runs attached to brooders—in fact, all land on which chickens are run—should be thus treated every season. Many breeders sow down a number of runs each year with rape for the reception of chickens after leaving the brooder. This is an excellent idea, as not only are the young birds provided with all the green food they require, but in addition they can secure shelter from winds and the desired shade from the hot summer sun.

Clean houses and runs are, however, only links in the chain of management. Among other important details which must be observed are sound and liberal feeding, an ample supply of green-stuff and grit, plenty of room for exercise, and, above all, the birds must not be overcrowded.

PROFIT AND FEEDING.

In view of the present declining market value of eggs compared with the prices of foodstuffs it is safe to say that many flocks are showing little profit over the cost of their keep. It is therefore a time when the difference between sound and weak methods of management will be most marked. To the man who has previously managed his business on proper lines, has rigorously culled out unprofitable stock, has only the very best two-year-old hens on hand, has no surplus male birds, and has a strong flock of pullets laying heavily, the plant should be showing a fair return over cost of production. In other words, decent wages should be secured. On the other hand, the poultryman who has resorted to weak methods of management will find the present position most trying and disappointing. The weakness in the latter case is too often intensified by a reduction in the ration, made because the anticipated profit is not coming to hand. This is a serious mistake, as if the birds are to be expected to lay to their full capacity it is obviously false economy to stint their diet.

It is well known that it is impossible to overfeed the bird of high-laying propensity with food of the right quality. An exception to the latter statement may exist in that it is possible to overfeed before a bird comes into profit, especially where ample provision is not made for it to exercise. At this period of the year, however, any bird, providing it is of the desired laying-type and receives common-sense treatment, should be in productive condition—a condition which demands good food and plenty of it—for the manufacture of the egg-product. Thus, if it is found that the returns do not justify giving the flock all they can eat of good-quality food, it is indicated that at least the majority of the birds are not of a laying-type. In such cases the only safe course is to retain only those fowls that will show a profit. In other words, "feed better and keep fewer."

FIGHTING INSECT PESTS.

In view of the approach of hot-weather conditions, when insect pests give most trouble, it is most necessary to keep the quarters free from these enemies of poultry. The best bird ever hatched will fail in production if compelled to sleep in lice-infested houses. It must not be thought because vermin cannot be seen in the house that they are not there. Some of the most dangerous parasites that infest fowls, such as the red mite, work at night and hide themselves by day. Strict attention to cleanliness and thorough spraying with strong disinfectant, especially in the corners and crevices, are the chief essentials in keeping these pests in check. Perches should also be frequently washed with disinfectant or kerosene, as usually it is on these that the red mite first makes its appearance.

Fleas are another form of parasite which causes no end of annoyance to fowls, especially in certain parts of the North Island. Like the red mite, the flea is a night marauder. Its favourite hiding-place is under the nesting-material. Thus if it is to be kept in check the latter must be frequently renewed and dusted with insect-powder.

In regard to body-lice, which live on the fowls at all times, these are not so harmful as the other pests referred to, but they must be got rid of if the birds are to be maintained in a healthy thriving state. Dust-baths, which are nature's remedy, should be provided to enable the birds to free themselves from these pests. Where dust-baths are provided inside the house the dusting material should be frequently renewed and kept moist by means of a spray of water. In the latter condition it will be better appreciated by the birds than when in a dry state. Of course, where fowls are not confined to the house, the best place for a dust-bath is on the sunny side of a shrub in the run. Any dust-bath should be frequently spaded up, as the moist earth will induce the birds to dust themselves, especially during hot weather.

—F. C. Brown, Chief Poultry Instructor.

THE APIARY.

It is assumed that by now the bees will have received their first spring overhaul, the food-supply attended to, queenless colonies disposed of by being united with others that are queen-right, and diseased colonies either destroyed or marked for later treatment. The weather is now becoming warmer, and in consequence manipulation of the bees is a more pleasant task. Experience teaches that the best time to handle bees is while the sun is shining brightly, preferably sometime between the hours of 9 a.m. and 3 p.m. It will be observed that even in the summer-time, when nature is ablaze with bloom and honey is coming in, there is a noticeable difference in the temper of the bees in the earlier hours of the day and toward evening. This is no doubt due primarily to a lesser honey-flow during these hours as a result of a lower temperature. It is not good practice to expose the brood unnecessarily at any time, and it is courting disaster to do so during cold weather. Every care should therefore be exercised in the early spring work to avoid chilling the brood. Bottom-boards should be cleaned as opportunity offers. There is often found on the bottom-board an accumulation of dirt that retains the moisture, setting up damp conditions that are injurious to the bees and tending to rot the board itself. Cappings, too, sometimes accumulate and furnish a home for the wax-moth. If a super has been left on during the winter months it may be found that the bees have left the original brood-chamber and established themselves in the super. In such case the position of the boxes should be reversed, or the empty one taken away altogether.

BUILDING UP THE APIARY.

With the return of warm weather the weaker colonies can safely be built up by giving them frames of sealed brood taken from the strong colonies. This is best accomplished as follows: In going through the hives it may be found that some had eight frames of brood, others six, others four, and some even less. To build up the apiary as a whole to the best advantage a frame of sealed brood should be taken from a colony having eight frames and given to one having only six frames. A fortnight or three weeks later the colony next in strength may be reinforced, leaving any that are really only two-frame or three-frame nucleus colonies until the last. It is sometimes a good plan to strengthen a weak colony by changing stands with a strong colony.

In districts where pollen is plentiful the brood-chamber is often defined by a comb on either side choked with pollen. As the bees build up these combs should be drawn to the outside of the hive, putting clean empty drawn combs—not foundation—in their place

Do not fail to attend to the food-supply. The bees require more than they are able to gather at this time of the year in most districts. Empty combs make very good feeders. To fill a comb place it on a tray and spray the syrup into it as from a watering-can—a tin with the bottom perforated answers the purpose. Fill both sides. A simple and inexpensive feeder is made by cutting a benzine-tin to form a tray 2 in. deep. A few pieces of wood are placed in the tray to form floats, and a piece of rag folded over its edge to give the bees foothold. Place the feeder on the mat, drawing the mat back an inch or two from the end to allow the bees to come up. Do not stint the food-supply, as brood-rearing will fall off if the bees have to live "from hand to mouth." Syrup made by mixing one cup of No. 1A sugar with two cups of water is the best for this time of the year.

—H. W. Gilling, Apiary Instructor.

THE GARDEN.

VEGETABLE-CULTURE.

In northern districts the planting-out of tomatoes will now have been commenced. Growers are referred to the notes on black-stripe in the July *Journal*. With regard to manuring, there has in some quarters been too much use made of nitrogenous fertilizers, which, unless potash is also applied to stiffen growth, tends to the production of luxuriant plants susceptible to disease. The addition of potash, while it does not check the growth of the plant, renders it more solid and stiffens it up; moreover, it improves the fruit, making it firmer. One of the best and largest growers in the Dominion has written to us verifying this statement. In colder districts growers are advised not to try to get ahead of the season. It is rarely safe and never wise to plant until continuous warm weather can be relied on.

French and runner beans may be sown early in October in all places. Canadian Wonder is the best for first sowing. Wood's Centenary, a golden-podded variety, appears to be the hardiest of this tribe. It can be sown soon after Canadian Wonder. The sowing of other vegetables, as enumerated last month, should be carried out at once, if not already done.

Thinning young crops—onions, carrots, &c.—should be attended to. The smaller the seedlings the easier the work and the better for the crop. The soil between rows of seedlings should be kept clean by cultivation. As shallow a surface as is possible should be disturbed, particularly in dryish soils. The object sought in preserving a loose surface is to prevent loss of moisture by evaporation. Water does not rise except in a closely compacted soil, hence if a depth is now loosened suitable for summer conditions when plants have a good roothold, small seedlings may suffer through being too dry.

MANURING FOR THE GARDEN.

A few notes on this subject are offered with the hope that they may remove false impressions as to the value and use of some fertilizers. The prominence given to forms of phosphatic fertilizers—superphosphate, basic slag, and the Nauru and Ocean Island phosphate—is perhaps largely responsible for the impression that a phosphate is all that is required. Some of the other elements required by plants are found naturally in the soil, and farm practice is so arranged as not to exhaust these natural supplies. Areas used for cropping are frequently changed and grazing-animals return fertilizers in their excreta. All that has to be made good is the actual amount taken away—such as in milk, meat, and bone, &c.—and even a proportion of this is made good by natural forces. Again, it is quite a common practice with farmers to plant potatoes on a newly broken-up paddock where cows had grazed, no fertilizers being used for the potatoes. Good crops are usually obtained—I have seen an average of 15 tons per acre lifted. The following season the area is usually again cropped with potatoes, it being considered that, the turf having had time to become thoroughly disintegrated, the soil will be in better physical condition than the previous year and able to produce another good crop. Generally a light application of superphosphate is given on the second occasion, the result being satisfactory.

The case of a garden is quite different. More or less intensive cultivation is practised, the same soil is cropped year after year, and practically all the produce is carried off. It is evident that a system of manuring that is suitable for farm practice will not do for a garden; more complete fertilizers must be used. Manuring must also be supplemented by methods of cultivation suited to the case. Deep trenching is an important means of maintaining a state of fertility in the soil; provided the soil is efficiently drained air penetrates to a greater depth in trenched ground and increases the activity of soil-bacteria. After some years of continual cropping the top soil becomes less fertile, but fertility can be restored by retrenching, bringing the bottom soil to the top.

For the present purpose it will be sufficient to state that the chief manurial requirements of plants are lime, phosphoric acid, nitrogen, and potash. In farm practice, for reasons stated earlier, it is not always necessary to directly apply all these elements, but this is essential in a garden subject to continuous cropping. Humus also is necessary; no soil lacking in humus is fertile. This is one

reason why stable or farmyard manure is more valuable for vegetable-culture than any other material, the humus content being in the best form. Vegetable-gardens can be, and have been, kept in a fertile condition for many years by the use of only stable manure and lime, the lime being necessary to correct acidity of soil which the constant use of stable manure causes. It has in the past been quite common practice to use no other manure, except occasionally nitrate of soda to help lagging crops, and wood-ashes, which are incidental in most gardens, to supply an extra amount of potash to crops that need it, such as potatoes, onions, leeks, tomatoes, &c. The reason why stable or farmyard manure is so valuable is that, apart from its humus value, it is what may be termed a complete fertilizer—that is, it contains varying proportions of all the elements required.

Other complete manures are as follows: Seaweed, richer in potash than stable manure, is of lower value because the form of humus is not so good. Cow-dung, not so rich as stable manure, is specially good for light or sandy soils; if used to any extent on heavy or medium heavy soil it does harm by making the soil hard to work and closing it up to the exclusion of air. Sheep-manure ranks in value between the two; it is richer in nitrogen than either. Fowl-manure is complete if properly stored, but in a fresh state is not so rich. It should be stored in a dry place, mixed with an equal amount of dry soil, and used at the rate of 1 lb. to 2 lb. per square yard. Lime or wood-ashes should not be mixed with it, as the lime of which wood-ashes are largely composed would drive off the ammonia, which is the most valuable constituent.

Soot is a useful fertilizer for soil not deficient in humus; about 7 lb. per square rod may be used, and should be exposed to air—but kept dry—for a few weeks before being used.

Commercial Fertilizers.—Phosphatic—Superphosphate, Nauru phosphate, basic superphosphate, basic slag, and bonedust: Basic slag contains a large amount of lime; it is slow-acting, because the phosphoric acid is insoluble in pure water but is slowly soluble in soil-water. Slag is therefore not suitable for dry conditions. Basic super contains a small amount of lime, this lime base rendering it best for use on soils wanting in lime; the same applies to basic slag. Bonedust contains also a certain amount of nitrogen.

Potassic—Kainit, sulphate of potash, and muriate of potash: Nearly half of the bulk of kainit consists of common salt. Except for such crops as asparagus and beet—seaside plants which the salt may benefit—it should be applied during winter or early spring so that rain may wash away the salt, which would injure tender roots that might come in contact with it. Sulphate of potash is refined kainit, nearly all the common salt having been removed. Muriate of potash is the potash equivalent of common salt (chloride of sodium). It is highly irritating and injurious in contact with the roots of some plants, particularly strawberries; it is not difficult to completely kill strawberry-plants by manuring with muriate of potash in spring. When applied to any crop it should be kept well away from young seedling plants.

Nitrogenous—Dried blood, nitrate of soda, and sulphate of ammonia: Dried blood contains a little phosphate and potash, but its chief value is for nitrogen; some authorities completely ignore its other properties. A mixture of blood and bone makes a nearly complete fertilizer, and is valuable for vegetable-growing as well as for fruit-trees. It has to be remembered that blood is a slow-acting manure and is not the best in all circumstances, also that it is best to change the fertilizer occasionally. Nitrate of soda is quick-acting and is valuable for pushing on certain crops—cabbages, cauliflowers, onions, and leeks in particular. As it is quickly washed away by rain it should be applied only to growing crops, and only in small doses. A full dose is at the rate of 1½ cwt. per acre, while 2 cwt. is the maximum to apply. Any heavier application would be too forcing, producing flabby growth. An excess amount might also injure the plants, for it is a very efficient weed-killer. Sulphate of ammonia is slow acting and should be applied in one application early in the season. It becomes available only by degrees, and for this reason is good for such crops as potatoes and tomatoes; it promotes steady growth without a forcing effect.

Summary.—A sufficiency of lime in the soil is necessary. Where there is much organic matter in the soil, such as abundance of farmyard or stable manure, or on peaty soils, air-slaked quicklime is best. The application of ½ to 1 ton per acre every fourth or fifth year is usually but not always sufficient. For soils poor in humus, ground limestone should be used, giving at least double the

weights recommended for quicklime. Humus is necessary; where this cannot be supplied by animal manures green crops should be grown, preferably legumes such as field-peas or lupins, and turned under. White mustard is valuable where the time available is short, as it develops very rapidly. Phosphates are useful for all crops; they stimulate root-action, help build the framework of a plant, and hasten maturity. Nitrogen affects only the green growth of plants; it imparts vigour and strengthens plants, and is especially valuable for crops where good development depends on leafage, such as in all the cabbage family and onions. Potash has the same effect on the fruit of a plant as does nitrogen on the green growth. It stiffens the tissues, making plants better able to withstand disease, and counteracts a tendency to too early maturity. In garden practice it is required for all plants. Peas require potash and little nitrogen. Cabbages, cauliflowers, and onions require both. Carrots, parsnips, and beet-root succeed with superphosphate and potash; in gardens where stable or farmyard manure is used these do best on a plot that was well manured the previous year for another crop, no further manure being then added.

—*W. H. Taylor, Horticulturist.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

MORTALITY AMONG THE FINEST LAMBS.

J. FARQUHAR, Hastings:—

Each year I find quite a number of the best and largest lambs lying dead in the paddocks. Some of my neighbours say the cause is wool-ball, but perhaps you can tell me what the actual cause is and a remedy for it.

The Live-stock Division:—

Death of the best and largest lambs is probably caused by renal congestion. When a *post mortem* examination is made the organs may appear healthy, but usually the kidneys are overlooked and the cause of death put down to wool-ball. Wool-balls are practically always present in the lamb's stomach through a strand or two being swallowed frequently while the lamb is sucking, but this very seldom causes death. If the kidneys are examined they will be found to be enlarged, dark-coloured, and often so soft and extremely pulpy that they cannot be removed in a complete condition. Frequently, if the capsule be ruptured, only a dark pulpy mass can be secured. The condition seems to be set up by a too abundant and too rich supply of food. Usually it appears when lambs are between four and eight weeks old and when the milk of the mother is beginning to be supplemented by grass. In other words, all that tends to induce a plethoric condition in the lamb at this age, before it has begun to take exercise far afield from its mother, predisposes to the disease. It usually occurs with single lambs. After castration the disease rarely appears in ram lambs, but with ewe lambs, especially those which have been docked at from seven to ten days old, it may appear later. This means simply that ample bleeding, by reducing the plethoric condition, removes the predisposing cause. For treatment remove the ewes and lambs to a paddock where feed is not so abundant, when the milk-supply of the ewe will lessen. Prevention consists simply of docking before the dangerous period of life occurs. In the case of ewe lambs which it is necessary to dock early the tails should be left sufficiently long to permit of another joint being removed if this is found advisable later on. This reduces the condition by bleeding, and so will prevent further loss by the disease.

LUCERNE AND RED CLOVER IN ORCHARDS.

"TANGATA-ROA," Ashburton :—

I should be pleased to have the Department's opinion as to whether lucerne grown between trees in a young orchard would be detrimental or otherwise to the welfare of the trees. If this procedure is not advised, would red clover be harmful as compared with clean cultivated ground ? I find that much labour is necessary in order to keep the orchard free from weeds, and if the area could be used for growing of green feed a great saving of labour would be effected.

The Horticulture Division :—

Experimental work is necessary before an authoritative opinion can be formed on this question in a specified case. The effect of the crop on soil-moisture has to be considered. On deep soils the drying effect might not be great, as the roots would find moisture at a depth the roots of fruit-trees do not reach. On shallow soils lucerne would be sure to deprive the trees of necessary moisture. In districts subject to a fair amount of rain during the growing-period of the trees the foliage of such a crop might be expected to hold moisture, and this would be likely to encourage fungous diseases. It is true that lucerne is grown in many orchards in California. There, however, the climate is exceptional, being similar to the normal climate of Central Otago or the drier part of Hawke's Bay—having little or no rain in summer. In California lucerne is grown in the alleys, not close to the trees. No fruit-tree could thrive with lucerne or red clover growing close round it. In some Californian orchards the crop is cut and left as a mulch, some being placed round the trees ; in others it is allowed to stand. It is not taken off and fed to stock, which is a treatment that could only result in starving the trees. This applies to red clover equally with lucerne.

ABORTION DISEASE OF CATTLE.

A. E. B., Te Kura, Otane :—

I have a bull running with in-calf cows, some of which have since aborted. All the cows were in calf before the bull was put in the paddock. Is there any chance of the bull being infected with the germs of the disease through nuzzling the water from the cows ? How long do the abortion germs live in an expelled unburied fœtus ?

The Live-stock Division :—

It is quite possible for a bull to become infected through nuzzling the water and discharges from the cows. He may also become infected through eating grass, &c., on which discharges have dropped. The vitality of the germ is considerable, although the organisms are easily and quickly destroyed by weak solutions of the ordinary disinfectants ; at the same time, if kept moist they may live for a considerable period outside the animal-body. Living bacilli have been obtained from the dark-brown, putty-like exudate surrounding a mummified fœtus, though the latter had been dead nine months.

GRASS-GRUB IN THE VEGETABLE-GARDEN.

"SUBSCRIBER," Gisborne :—

What is the best way to rid a vegetable-garden of the grass-grub ? I notice that in the last June *Journal* (p. 381) a carbon-bisulphide treatment is advised for the grub in lawns, but I do not know if the same treatment would do for a vegetable patch. What period must elapse after applying remedy before planting of vegetables is carried out ?

The Biologist :—

The fumes of carbon bisulphide, when liberated in the soil, have the tendency to make the conditions untenable for grass-grub. In vegetable-gardens when the ground is damp and when the grubs are active the following procedure may be followed : Pierce a line of holes about 8 in. deep and 1 ft. 6 in. apart along each row of plants with a thick stick. In each hole place a gelatine capsule (size No. 13) filled with carbon bisulphide and cover over, first pouring some water

into each hole. The gelatine capsule will dissolve and the carbon bisulphide be liberated. Planting could be carried out about a week after the treatment. This treatment should be carried out when the grubs are near the surface and feeding. During cold weather they go deep into the soil and surround themselves with a cocoon of earth.

CUTTING SAGE AND THYME.

"GARDENER," Blenheim :—

Will you kindly tell me the right time at which to cut sage and thyme for marketing purposes ?

The Horticulture Division :—

The time for cutting sage and thyme depends on what it is intended for. Butchers and others require it at all times of the year and in a fresh state. Cutting for this purpose can be done at any time when there is young growth to cut. If you wish to dry the herbs and keep them for winter use, cut during the month of March. Tie in bundles and hang them from the roof of a shed to dry. They must be kept out of the sun, but should have plenty of air. Run the strings through sheets of paper, which will protect the bundles from dust.

MIXING SUPERPHOSPHATE AND CARBONATE OF LIME.

"INQUIRER," Manurewa :—

I have been advised to use a mixture of superphosphate and carbonate of lime for top-dressing, but I find that after leaving the mixture for three or four days it sets hard. Can you inform me if the same result can be obtained by, say, mixing it in the morning, turning it at night, and sowing it the next morning ?

The Agricultural Instruction Service :—

Carbonate of lime and superphosphate should be mixed just before sowing, and kept well stirred by turning it over, which will prevent it setting hard. If you mix it one day you would be well advised to apply it the following day. An alternative practice, which is a very good one when top-dressing pastures, is to apply 10 cwt. to 20 cwt. of lime on the land in the autumn, and in the following spring apply super. This practice allows the lime to sweeten the ground, and it is made soluble by the winter rains. Super acts better on well-limed land than on land deficient in lime.

COW WITH INJURED TEAT.

P. J. W., Waimate :—

A cow last season had an injury to a teat, caused by a tear, which penetrated to the milk-duct. This was sewn, and it healed with the exception of a small hole through which the milk escapes when the udder is full. How can this escape of milk be remedied ?

The Live-stock Division :—

The teat should be thoroughly cleansed with warm water and an antiseptic such as lysol (one teaspoonful of lysol to one pint of warm water). The skin around the hole should be scraped with a small, clean, sharp knife until it commences to bleed. The teat must then be thoroughly dried and flexile iodoform collodion painted over the hole in the teat. The cow should be carefully milked, and the teat should be painted over with collodion after each milking until a good solid patch is formed. Unless the teat is thoroughly dry before applying the collodion it will not adhere. A good way to ensure thorough dryness is to wipe the teat with a piece of clean rag moistened with petrol or benzine.

Sheep Returns.—The statistics for 1922 (30th April), printed on pages 190 and 191, show that although the total number of sheep in the Dominion decreased by 1,062,772 compared with the preceding year, the number of breeding-ewes increased by 348,266. Merino sheep increased by 62,784. The number of sheep-owners in the Dominion decreased by 594 (from 24,394 to 23,800).

INTERNATIONAL INSTITUTE OF AGRICULTURE.

MEETING OF THE GENERAL ASSEMBLY.

THE meeting of the sixth General Assembly of the International Institute of Agriculture, held at Rome from 8th to 16th May last, was attended by Mr. W. H. Montgomery, C.B.E., in conjunction with Sir Thomas Elliott, the British delegate on the Permanent Committee of the Institute, who also acts as the representative of New Zealand. A report by Mr. Montgomery, comprising notes on the Institute and the proceedings of the Assembly, together with various related documents, has been received from the High Commissioner, London, and is printed below (slightly abridged) as of interest to the agricultural community and the public generally. Mr. Montgomery states :—

The idea of an International Institute of Agriculture originated in the mind of Mr. David Lubin, a citizen of the United States of America. He communicated the project to the King of Italy, who made it his own, and in 1905 an International Conference called by him agreed to establish such an Institute at Rome. Practically every State in the world has now adopted this treaty. The Institute is installed in a magnificent edifice erected by the munificence of H.M. Victor Emanuel III. The office contains a valuable agricultural library of over seventy thousand volumes and pamphlets. It includes the latest New Zealand statutes and agricultural publications. The management of the Institute is entrusted to a General Assembly of Delegates and a Permanent Committee. The Assembly meets, as a rule, every two years. Meetings were held in 1908, 1909, 1911, 1913, 1920, and 1922.

The decisions of the General Assembly are carried out by the Permanent Committee through four Permanent Commissions, namely :—

First Commission—Secretariat, including the Bureau of Legislation and the Library. The Secretary exercises a general control over all the Commissions. The First Commission publishes the International Year-book of Agricultural Legislation.

Second Commission—Bureau of Statistics. Publishes the International Year-book of Agricultural Statistics; the *International Crop Report and Agricultural Statistics*, known as the "Bulletin," monthly in three parts—(1) Prices, (2) Production, (3) Trade and Stocks; and *Documentary Leaflets*.

Third Commission—Bureau of Agricultural Intelligence and Plant-diseases. Publishes monthly the *International Review of the Science and Practice of Agriculture*.

Fourth Commission—Bureau of Economic and Social Intelligence. Publishes monthly the *International Review of Agricultural Economics*.

All the Commissions also publish monographs or brochures on special subjects.

A perusal of the subjects dealt with in the publications will show that they cover an extremely wide scope. This is in accordance with the letter and spirit of Article 9 of the treaty, which not only authorizes the collection and distribution of agricultural statistics, but includes such subjects as "the wages paid for farm-work" and the "submission to the approval of the Governments of measures for the protection of the common interests of farmers." The question of the jurisdiction of the Institute with respect to the conditions of life and wages of farm labourers has already been questioned by the International Labour Office, and it is understood that a conference is to be held at Geneva to decide which body shall continue this work. At present the Institute has a clear right to do so, but, on the other hand, it is not a body which especially represents labour. This is, however, only one aspect of the larger question of the formation of an international statistics bureau, which it is understood is under the consideration of the League of Nations.

Though the authority of the Institute to make inquiries into agricultural matters is theoretically boundless, there is a very practical limit to its activities in the shape of finance. Hence the "Bulletin" specializes on a limited number of cereals, and deals fully with wheat, rye, barley, oats, maize, and rice only. Statistics relating to rubber and cotton are also given, but wool, frozen mutton,

and dairy-produce receive little attention. In spite of the limited finance, there is at the same time a constant pressure by enthusiasts to introduce new subjects for "documentation" of special interest to themselves.

The most important problem at present before the Institute is not what new work it shall do, but how it shall carry on with a diminished finance. The contributions received before the war were barely sufficient to meet the expenditure. Since the war, expenses are said to have increased four times, owing to the rise in the cost of living and the fall in the rate of exchange. Extraordinary contributions were levied in 1921 by the consent of nearly all nations. Canada, Australia, and South Africa have all made such extraordinary contributions. It must be remembered, however, that New Zealand's original contribution was 5,000 francs per annum, as against Australia's 10,000 francs and Canada's 20,000 francs, so that New Zealand is really now paying in proportion to its population as much as Australia or Canada, including their extraordinary contributions. There can be no doubt that the work of the Institute is hampered by want of funds, and that its efficiency would be increased if salaries could be paid commensurate with the importance of its work.

An international agricultural institute can be regarded from two points of view. First, such an institution is a world necessity. The collection and diffusion of information as to the production, exports, imports, stocks, and prices of the world's stores of food must be undertaken by somebody for the information of all countries. It is an organized effort which should relieve individual nations from the work of collection of similar statistics. It is an experiment in international socialism. From this point of view it should receive the generous support of all nations. It is really an economy of effort.

But, while not forgetting the larger vision, each nation will inevitably inquire what particular benefits it will derive from such an institution. From the somewhat parochial viewpoint it must be admitted that New Zealand receives little direct benefit. Our export of cereals is so small that world statistics are of little value, and we are so far away that the annual and the monthly statistical returns become stale before they reach us. It so happens that our main exports —wool, frozen meat, and dairy-produce—have hitherto received little attention. I have suggested to Sir Thomas Elliott that as these form a large proportion of the food-supply of the world they should receive more consideration. What we really desire to know is not so much the production of last year, but the supplies in hand and the probable sources and quantities of supplies of the future. The Institute appears to look too much to the past and not to forecast the future.

Had it been necessary to determine important points of agricultural policy the notable gathering of experts who attended the meeting of the Assembly would have been well qualified to decide what measures should be taken. Fifty-one countries were represented, and thirteen delegates came from the United States alone. But the conference was rather in the nature of an annual meeting of a joint-stock company, when the chief business is to receive the report and balance-sheet and to pass the accounts for the year. It could not well be otherwise. The policy was laid down in 1905. There is not only a permanent staff, but a permanent committee. No questions of policy of importance were brought forward. The financial position precluded any new developments, and the business centred round the reorganization necessary to carry on the work with a diminishing revenue. Reports there were in plenty. The most comprehensive was that of M. Louis Dop, the vice-president, which was really a complete history of the Institution from its foundation. The different commissions also sent reports and recommendations, and individual delegates presented memorials on special subjects. There was a great deal of printing, but the proceedings of the Assembly were largely formal, though much detailed work was attended to in committee. The general impression left was that the Institute was doing valuable work, and that it could with advantage develop in many directions if further funds were available.

An interesting discussion took place on the American proposal to place the English language on a par with French in the proceedings of the conference. This was finally agreed to.

Perhaps the most important innovation was the offer of the American delegation to place at the disposal of the Institute free of charge three experts in statistics, economics, and the diseases of plants. If this generous example were followed by other countries the efficiency of the Institute would be greatly increased.

ANNUAL SHEEP RETURNS, 1922 (30TH APRIL).

TABLE I.—SUMMARY BY SHEEP DISTRICTS.

Class.	Auckland.	Napier-Gisborne.	Wellington-West Coast.	Marlborough-Nelson-Westland.	Canterbury-Kaikoura.	Otago (including Southland).	Total in Dominion.
Stud rams	675	871	3,314	886	4,020	2,622	12,388
Other rams	22,944	80,569	66,698	17,471	68,048	53,954	309,684
Wethers	245,718	522,616	568,745	220,316	535,954	634,275	2,727,624
Breeding-ewes	907,206	3,231,301	2,632,975	703,710	2,746,728	2,274,134	12,496,054
Dry ewes	73,533	252,993	199,377	66,870	196,968	170,307	960,048
Lambs	455,079	1,536,651	1,294,540	335,191	1,033,123	1,061,877	5,716,461
Totals, 1922	1,705,155	5,625,001	4,765,649	1,344,444	4,584,841	4,197,169	22,222,259
Totals, 1921	1,901,947	5,705,715	5,166,661	1,438,055	4,796,060	4,276,593	23,285,031

TABLE II.—COMPARATIVE STATEMENT: TEN YEARS, 1913–22.

Year.	Stud and Flock Rams.	Stud Breeding-ewes.	Stud Dry Ewes.	Stud Lambs.	Total Stud Sheep and Flock Rams.	Sheep of Distinctive Breed not entered in Flock-book, and Crossbred Sheep.				Grand Total, Stud and other Sheep.
						Wethers.	Breeding-ewes.	Dry Ewes.	Lambs.	
1913	313,690	228,145	12,902	167,605	722,342	3,207,550	12,292,891	1,150,805	6,818,222	24,191,810
1914	321,869	229,055	13,526	170,169	734,619	3,211,661	12,691,121	1,152,749	7,008,613	24,798,763
1915	315,251	237,717	17,341	176,556	746,865	3,270,221	12,377,624	1,365,119	7,141,592	24,901,421
1916	316,131	252,201	15,012	175,155	758,499	3,478,263	12,640,566	1,189,023	6,721,799	24,788,150
1917	329,230	160,212	6,212	114,778	610,432	3,457,824	13,099,957	1,066,435	7,035,738	25,270,386
1918	325,111	171,437	6,297	125,116	627,961	3,696,520	12,850,597	1,592,452	7,770,772	26,538,302
1919	321,304	165,676	12,196	127,150	626,326	3,922,632	12,176,224	1,799,201	7,304,171	25,828,554
1920	306,621	154,516	9,803	109,454	580,394	3,901,742	11,415,159	1,814,391	6,208,284	23,919,970
1921	322,144	158,608	9,513	110,428	600,693	3,634,799	11,989,180	1,336,306	5,724,053	23,285,031
1922	322,072	154,277	7,259	98,221	581,829	2,727,624	12,341,777	952,789	5,618,240	22,222,259

NOTE.—Stud sheep returned since 1917 are only those entered in Flock-books.

TABLE III.—DISTRIBUTION OF THE VARIOUS BREEDS AND OF CROSSBREDS IN EACH SHEEP DISTRICT (1922).

Breed.	Auckland.	Napier-Gisborne.	Wellington-West Coast.	Total in North Island.	Marlborough-Nelson-West-land.	Canterbury-Kaikoura.	Otago.	Total in South Island.	Total in Dominion.
Stud sheep (entered in Flock-book)—									
Merino	1	..	..	1	7,557	13,715	2,339	23,611	23,612
Lincoln	1,213	3,534	13,502	18,249	630	453	1,339	2,422	20,671
Romney	9,707	11,607	64,444	85,758	7,482	8,168	22,045	37,695	123,453
Border Leicester	328	..	895	1,223	240	9,918	9,724	19,882	21,105
English Leicester	420	613	366	1,399	1,418	21,774	606	23,798	25,197
Shropshire	194	..	544	738	164	2,107	251	2,522	3,260
Southdown	484	3,685	9,378	13,547	197	6,437	344	6,978	20,525
Corriedale	232	..	121	353	136	27,600	5,342	33,078	33,431
Other breeds	48	..	162	210	..	649	32	681	891
Totals	12,627	19,439	89,412	121,478	17,824	90,821	42,022	150,667	272,145
Sheep of a distinctive breed but not entered in Flock-book—									
Merino	2,959	13,014	19,641	35,614	185,850	373,912	246,917	806,679	842,293
Lincoln	13,546	83,541	54,263	151,350	5,293	17,691	7,343	30,327	181,677
Romney	181,019	994,230	693,031	1,868,280	150,878	68,913	345,549	565,340	2,433,620
Border Leicester	2,546	5,034	2,811	10,391	1,495	46,476	48,396	96,367	106,758
English Leicester	1,250	1,170	781	3,201	7,584	85,503	4,230	97,317	100,518
Shropshire	2,190	148	547	2,885	1,057	4,410	759	6,226	9,111
Southdown	1,241	10,800	25,623	37,664	133	6,304	151	6,588	44,252
Corriedale	536	1,993	12,529	15,058	5,675	298,080	243,598	547,353	562,411
Half-breds	18	397	39	454	185,378	662,264	282,015	1,129,657	1,130,111
Other breeds	416	652	4,123	5,191	2,585	37,650	4,766	45,001	50,192
Totals	205,721	1,110,979	813,388	2,130,088	545,928	1,601,203	1,183,724	3,330,855	5,460,943
Crossbreds and others not otherwise enumerated	1,486,807	4,494,583	3,862,849	9,844,239	780,692	2,892,817	2,971,423	6,644,932	16,489,171
Grand totals ..	1,705,155	5,625,001	4,765,649	12,095,805	1,344,444	4,584,841	4,197,169	10,126,454	22,222,259

GRADING PERCENTAGES OF BUTTER AND CHEESE.

ANALYSIS of the figures representing all gradings of dairy-produce throughout New Zealand during the year ended 31st March last shows that of the total quantity of butter passed through the grading-stores 94·39 per cent. scored first grade (88 points and over), 5·60 per cent. was classed as second grade (80–87 points), and 0·0095 per cent. third grade (under 80 points). Within the first grade the different scores made and the percentage of the total gradings represented by each were as follows: 96 points, 0·048 per cent.; 95½ points, 0·489; 95 points, 1·543; 94½ points, 2·744; 94 points, 6·161; 93½ points, 8·661; 93 points, 10·778; 92½ points, 10·818; 92 points, 12·384; 91½ points, 11·062; 91 points, 8·172; 90½ points, 7·268; 90 points, 5·367; 89½ points, 3·157; 89 points, 3·098; 88½ points, 1·965; 88 points, 0·668. In the second grade most of the butter scored between 85 and 86½ points, the quantity scoring 87 points being merely fractional, while none of the small proportion of third grade went below 77 points.

Of the cheese gradings 94·60 per cent. was classed first grade, 5·38 second grade, and 0·0131 third grade. Details of pointing in the first grade were as follows: 95 points, 0·004 per cent.; 94½ points, 0·056; 94 points, 0·335; 93½ points, 1·045; 93 points, 3·030; 92½ points, 5·454; 92 points, 10·257; 91½ points, 11·467; 91 points, 12·782; 90½ points, 13·033; 90 points, 13·340; 89½ points, 10·323; 89 points, 7·281; 88½ points, 3·323; 88 points, 2·868. Here again the second-grade article ranged mainly from 85 to 86½ points, and 76 points was the lowest score in the third grade.

FORTHCOMING AGRICULTURAL SHOWS.

Hawke's Bay A. and P. Society: Hastings, 18th and 19th October.
Marlborough A. and P. Association: Blenheim, 24th and 25th October.
Timaru A. and P. Association: Timaru, 25th and 26th October.
Ashburton A. and P. Association: Ashburton, 1st and 2nd November.
Manawatu and West Coast A. and P. Association: Palmerston North, 1st, 2nd, and 3rd November.
Canterbury A. and P. Association: Christchurch, 9th and 10th November.
Waikato A. and P. Association: Hamilton, 21st and 22nd November.
Stratford A. and P. Association: Stratford, 22nd and 23rd November.
Otago A. and P. Society: Dunedin, 29th and 30th November.
Auckland Metropolitan A. and P. Association: Auckland, 1st and 2nd December.
Hauraki A. and P. Association: Paeroa, 6th and 7th December.
Southland A. and P. Association: Invercargill, 12th and 13th December.
Woodville A. and P. Association: Woodville, 23rd and 24th January.
Helensville A. and P. Association: Helensville, 29th January.
Clevedon A. and P. Association: Clevedon, 10th February.
Rodney Agricultural Society: Warkworth, 10th February.
Dannevirke A. and P. Association: Dannevirke, 14th and 15th February.
Wellsford A. and P. Society: Wellsford, 16th February.
Rangitikei A. and P. Association: Taihape, 22nd February.
Franklin A. and P. Society: Pukekohe, 23rd and 24th February.
Katikati A. and P. Society: Katikati, 1st March.
Methven A. and P. Association: Methven, 15th March.
Temuka and Geraldine A. and P. Association: Temuka, 22nd March.

(Agricultural and Pastoral Association secretaries are invited to supply dates and location of their shows.)

ADVERTISING IN THE JOURNAL.

IT has been decided to resume the publication of general advertisements in the *Journal*. The Charles Haines Advertising Agency, Ltd., has been appointed sole agent for this business, and all inquiries regarding rates, space, &c., should be addressed to that firm, at the Dalgety Building, Featherston Street, Wellington (P.O. Box 1490).